





A Report on the Work done by  
the Research Staff under the  
Locust Research Entomologist to  
the Imperial Council of Agricultural  
Research at Karachi during the  
year 1935.

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A REPORT ON THE WORK DONE BY THE RESEARCH STAFF UNDER  
THE LOCUST RESEARCH ENTOMOLOGIST TO THE IMPERIAL  
COUNCIL OF AGRICULTURAL RESEARCH AT KARACHI  
DURING THE YEAR 1935.

BY

*Rao Bahadur Y. Ramchandra Rao, M.A., F.R.E.S., Locust Research Entomologist, Karachi.*

The present year's Report is submitted in three parts. Part I will deal with the General Report, Part II with the Experimental Work at Pasni Field Research Station and Part III with various miscellaneous items and will also include the present year's conclusions and suggestions for future work.

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I.—Personnel.

I was in charge of the Locust Research Scheme with headquarters at Karachi throughout the year.

*Ecological Staff.*—Dr. K. R. Karandikar, Ph.D. (Edin.), F.E.S., continued to work as the Assistant Locust Research Entomologist at the Pasni Locust Research Station till he resigned on the 8th September 1935. Dr. M. L. Roonwal, M.Sc., Ph.D. (Cantab.) was appointed in his place and joined duty on the 6th November 1935. Mr. A. C. Sen, M.Sc., continued to work as Locust Research Assistant at Pasni till the 25th June, after which Mr. Sayyid Mohd. Taqi Ahsan, M.Sc., working as Locust Research Assistant, in charge of the Ambagh Field Research Station, was posted to Pasni in his place on the 8th July. Mr. R. N. Batra, M.Sc., who had first been appointed as Mekran Survey Assistant at Pasni on the 27th May, was transferred as Locust Research Assistant, Ambagh on the 20th July. Mr. Rashid Ahmad, B.Sc., appointed as Biometrical Assistant at Karachi was temporarily posted to Pasni on the 1st September for assistance in the work at Pasni.

*Locust Survey Staff.*—I. *Khanpur-Bikaner Circle.*—Mr. Keshodas Baweja, M.Sc., was in charge of the Circle with headquarters at Khanpur till the 31st August 1935 after which date he availed himself of two years' leave granted by the Punjab Agricultural Department, to which he reverted. From 1st September, Mr. Des Raj Bhatia, M.Sc., Barmer, was placed in additional charge of this circle till such time as a suitable substitute could be appointed.

As recommended by the Locust Committee in January 1935, survey work was restricted mostly to intensive surveys in the East Jaisalmer and Bikaner areas. A new Locust Outpost was opened in May, 1935 at Nokh in East Jaisalmer, in addition to the one at Sardarshahr opened last year.

The headquarters of the Circle was changed from Khanpur to Bikaner from the 1st September.

2. *Mirpurkhas-Barmer Circle*.—Mr. D. R. Bhatia continued to be in charge of the work in this circle throughout the year. As decided by the Locust Committee in January 1935, survey work was confined to the desert areas of Thar-Parkar District, in Sind and the south Jaisalmer and Mallani areas of Rajputana. The headquarters of the circle was also transferred from Hyderabad (Sind) to Barmer in June 1935. A new Locust Outpost was opened in April in the village of Mahwar in the desert area, about 4 miles from Barmer.

3. *Mekran and Lasbela areas*.—The observation posts at Turbat, Gwadar and Ormara continued to function throughout the year under the control of the Assistant Entomologist, Pasni. In view of the importance of intensive surveys in Mekran, a new Fieldman was appointed to survey the areas in Dasht and Kulanch. As the Mekran Survey Assistant—Mirza Ahmed Ali Khan—reverted to the Baluchistan Administration on 1st April, a new hand—Mr. R. N. Batra, M.Sc., was recruited in May for supervising survey work in Mekran with headquarters at Pasni. As he had to be transferred to Ambagh in July, no arrangements for the regular supervision of survey work in Mekran could be made, except once in October in the Gwadar area by Mr. Rashid Ahmad. The supervision of the surveys in Lasbela was attended to by the Assistant at Ambagh.

*The Compiling Staff*.—Mr. Shanti Lal left the section on transfer at the end of January 1935, and Mr. Mohd. Ramzan, Second Clerk, was appointed in the vacancy in February. Since the 1st May, when he left the section on reversion to the Baluchistan Administration, the post has remained vacant, so that Mr. Chandar Parkash, B. Com., was the only hand available for this work during the greater part of the year. The Draftsman sanctioned for mapping work could be appointed only in September.

## II.—Items of Locust Research Work in progress during the year.

### 1. *Ecological Study of the Solitary Phase Locust in its natural Habitats.*

A. *Pasni*: as a centre for the winter-rainfall areas of Mekran Coast.

B. *Ambagh*: for the summer rainfall areas of the Mekran Coast.

C. Four Desert Outposts in the Indian Desert Area:

1. Centres for the Northern Areas: Sardarshahr, and Nokh.

2. Centres for the Southern Areas: Chachro and Barmer.

### 2. *Distributional Survey of the Habitats of the Locust.*

A. *Bikaner Circle*.—Bikaner and East Jaisalmer areas with Sardarshahr and Nokh as centres.

B. *Barmer Circle*.—Thar-Parkar District in Sind, and South Jaisalmer and Mallani areas, with Barmer and Chachro as centres.

C. *Lasbela Circle*.—Surveys in the Coastal reks and in the hinterland of Lasbela, with Ambagh as centre.

D. *Mekran Circle*.—Surveys in the Coastal reks, and in the hinterland of Mekran, including Keeli, Kolwah, Kulanch, Dasht and Panjgur, with Pasni, Gwadar and Turbat as centres.

### 3. *Study of the Locust Movements during the year.*

4. *Study of Old Records, and Compilation of Data on Locust Infestations in the past; Mapping of Locust Data.*

5. *Study and Correlation of Meteorological Data.*
6. *Study of the Fauna and Flora collected during Survey Work.*
7. *Biometrical Study of the Locust Collections.*

### III.—*Survey Work.*

*Tours.*—As decided at the Locust Committee Meeting of January 1935, work in the Sind-Rajputana areas was restricted to intensive surveys around the Desert outposts of Chachro, Sardarshahr, Nokh and Barmer and to longer surveys on a 50-100 miles radius around these centres in the desert areas of Thar-Parkar District, south Marwar, south and east Jaisalmer and Bikaner. In the south Baluchistan area, intensive work was carried on at Pasni, Ambagh and Gwadar, and longer surveys in the Kulanch-Dasht, Ormara, Kolwah-Kech-Panjgur and Hingol areas. Definite programmes of routes to be followed were chalked out for the guidance of Fieldmen.

On the whole, survey work was carried out far more frequently and intensively than in 1934.

In making locust surveys, the suggestions made by the Locust Committee were carried into effect. As far as possible surveys were made on foot, the party walking abreast and as far as possible straight ahead, at a distance of 10 to 20 feet from one another. The distance walked over during a day's survey was computed with the aid of a Pedometer, when available, or roughly with the aid of degree-sheets, and the population per square mile worked out each day. During the hot weather, the air temperature rises high at mid-day and the soil-surface becomes so hot that locusts retire to the shade of the nearest bush, while on the other hand, during winter locusts love to sit on the sand basking in the sun and are not easily disturbed. Otherwise, locusts are always to be seen seated on the sand surface and usually they are so active that there is little need of beating the bush to set them flying. When the day is warm, locusts are easily started and for estimating the population one may count the specimens as they fly out on either side as one proceeds forward. It has been found that, in the hot weather, a single man can efficiently cover a distance of 11 feet on either side with the aid of a pole in his hand. In the cold weather, of course, it is safer to compute at the rate of  $5\frac{1}{2}$  feet on either side per man. At times when the population is relatively dense and when long distances have to be covered, as for instance during surveys made in the Adasti-Chur reks of Pasni (about 15 miles long), it was found that counts of locust population could readily be made while proceeding slowly on camel-back, the huge hulk of the camel—with the riders on top of it, serving to start the locusts upto a distance of over 20 feet on either side. In these cases, the total area covered during a day's survey was calculated in sq. miles by multiplying the total distance travelled over (in miles) with  $\frac{22 \text{ ft.} \times \text{No. of men}}{5280 \text{ ft.}}$

or  $\frac{44 \text{ ft.} \times \text{No. of camels}}{5280 \text{ ft.}}$ . With the total area thus obtained; the population rate per sq. mile can be easily worked out. A count of hopper population, on the other hand, can only be made by a careful search, plant by plant, within a restricted area, which can be easily measured.

In addition to the intensive surveys over regular beats, three special tours were carried out during the year. 1. Mr. Keshodas Baweja and a Fieldman travelled on camel-back from Kandera in the Bahawalpore State to Tanot in Jaisalmer, and thence through Rangarh, Mohangarh and Nachna to Nokh, and thence to Srikolayatji in Bikaner State, during January and

February, 1935. 2. Mr. D. R. Bhatia toured in the west Sind and Kachhi areas in July-August at the time of the Locust incursion. 3. Fieldman Asaram travelled in October, from Thari in the Khairpur State, through Sorah and Santrahu, across the desert into south Jaisalmer at Mayajlar, and thence through Sheo upto Barmer.

Statements A-I, A-II, A-III, and A-IV contain particulars of all the tours carried out actually in the different circles, each tour being given a serial number for purposes of reference.

*Results of Locust Surveys.*—The results obtained this year have been classified under 2 headings: 1. *Results of extensive surveys*: which have been shown in Statements B-I, B-II, B-III, and B-IV for Bikaner, Barmer, Mekran and Lasbela Circles respectively, and 2. *Results of intensive surveys*: shown in Statements C-I for Pasni, C-II for Gwadar, C-III for Ambagh, C-IV for Chachro, C-V for Barmer, C-VI for Nokh and C-VII for Sardarshahr. They have been, moreover, classified according to the different seasons, and in order to simplify the details, only those places where locusts had been met with are listed, and notes added as to the number of locusts observed, the date of collection and wherever possible also an approximate estimate of locust population per square mile.

*Weather in the Desert Regions of North-West India during 1935.*—Before discussing the results of surveys, a review may perhaps be made of the character of the seasonal rainfall in 1935, as it may be of help in interpreting the locust developments of the year.

*Winter Rainfall.*—The first western disturbance of the winter of 1934 appeared on the 10th October, and altogether about 48 disturbances passed, from the direction of Iraq, over the region covering Iran, the Persian Gulf area, Baluchistan and N. W. India between October 1934 and May 1935. In addition, four minor disturbances made themselves felt in the region of the N. W. Frontier during the middle of June.

The winter season of 1934-35 was marked by heavy and even copious rainfall in many areas of Baluchistan and Southern Iran. Some rainfall occurred in the Bushire and Bahrein areas in the second half of November 1934, and during early December, there were some good falls at Bushire, Jask, Muscat, Sharjah and in Upper Baluchistan. Between the 21st and 27th December heavy falls were recorded at Jask, Muscat, Gwadar, Pasni and Ormara and in Upper Baluchistan. There were some falls in the Pasni-Gwadar sector between the 6th and the 10th January, after which a cold wave of unusual severity swept over N. W. India between the 12th and the 18th January, though it did not extend its influence to any appreciable extent westwards of Gwadar. Between the 21st and 24th January, rain fell at Muscat and Charbar and also in Upper Baluchistan. Between the 26th and the 31st January, a disturbance developed into a well-marked depression off Sind-Mekran Coast and gave wide-spread rainfall in Mekran, Upper Baluchistan, Sind, Punjab and Rajputana: Charbar 4", Muscat 3.70", Jask 2", Gwadar 5", Pasni 4", Ormara 4", Ambagh 0.02", and Barmer 1 inch. There were further heavy falls during the first fortnight of February: *Persian Gulf Area*—Bushire 2½", Henjam 3", Jask 6", Bahrein 1.50", Charbar 2", and Sharjah 3.50"; *Makran Coast*—Gwadar 0.80", Pasni 4.50", Ormara 4.50" and Panjgur 1.50".

After the 15th February, there was very little rainfall in most parts except between the 26th to 29th March in Upper Mekran and in the Rajputana area, and between the 4th and 9th April in the Ormara-Lasbela area and in Upper Mekran (Turbat, Panjgur), where good falls occurred.

In the Indian Desert area, scattered showers fell in January, February and April, especially in the Bikaner area and around Barmier.

There was thus a fairly early, as well as a heavy, winter rainfall in the Mekran area.

*Summer Rainfall.*—During the pre-monsoon period, there was no rainfall in the desert regions of N. W. India, and high maximum temperatures prevailed, Naushahro recording  $119^{\circ}$  on the 28th May and  $121^{\circ}$  on the 29th June.

The South-west Monsoon broke in Kanara on the 14th June, but did not extend its influence into N. W. India till the 7th July, when as the result of the influence of a depression travelling westwards from the Bay of Bengal, wide-spread rainfall occurred in Rajputana and Upper Sind. South Sind, Lasbela and Mekran, however, did not come within the sphere of its influence. About 5 to 7 inches of rain were received in most parts of the desert during July. During the 3rd week of August, fairly good rainfall occurred in Rajputana, Upper Sind, and S. E. Punjab as the result of another depression travelling westwards: Bikaner recording 3.50", Jodhpur 1", Barmier 1", Naushahro 2.30", Hissar 2", Khanpur 1", Badin 0.65", and Karachi 0.30". There were some scattered falls in the west Rajputana area at the beginning of September, and about the middle of the month, some increase of rainfall was brought about by the influence of a depression in the Central Provinces. The South-west Monsoon finally withdrew about the 20th September, and dry weather prevailed thereafter all over North India.

Since the beginning of October, Rajputana developed into an area of low humidity. North-easterly winds prevailed over this area and in Sind from about the 9th to almost the end of October.

Western disturbances have begun to reappear in the Mekran area from the 8th October, but have not given any rainfall so far, except in the extreme west at Bushire, where several falls occurred in November.

*Results of Survey work in 1935.*—The year under report has proved to be a most interesting one from the point of view of Locust Research Work. Various events which took place in the course of the current year have served to throw valuable light on several obscure points of the Locust Problem. The first event was the occurrence of an excellent winter rainfall—that was not only copious but unusually early, and the second, which followed therefrom, was the development of extensive breeding on the coastal reks. The third event was the receipt of a few reports of the occurrence of hoppers, during June-July, in a gregarious condition in the Mekran area. The fourth was the discovery of a very wide-spread incursion of locusts in such widely separated areas as Mekran Coast, Lasbela, Sind, Kachhi and Rajputana. Though hardly noticeable in most places, this incursion took the complexion of swarm movements in a few areas as in Khairpur and Jaisalmer. Fifthly, there was breeding in many of the desert areas, but owing to lack of sufficient rainfall, the locust invasion, which had threatened to start a new cycle, rather fizzled out. Lastly, specimens of locusts evidently of a recently developed generation began to appear in October-November at Ambagh, Hingol, Ormara and Pasni, possibly an instance of a return migration from east to west.

*Distribution of Locusts in winter and spring.*—A look at the results of the current year's surveys in the different areas between December and May would indicate rather prominently the general absence of locusts—with a few exceptions—in the Sind-Rajputana and Ambagh areas, and their presence in the Mekran Coastal areas. To find out if such an absence could be attributed to the phenomenon of hibernation during the cold season, a close



examination of bushes and rat-holes at their base was made in several places. In January, Mr. Keshodas Baweja uprooted over thirty large bushes in the Derawar desert area without finding any locusts in hiding. At the end of January, I had a large number of bushes and their bases exposed in the Ambagh reks, but without meeting with any. Subsequently, Mr. Taqi Ahsan dug out about 300 bushes in the same area with similar results. During my visit to Chachro in February, I had a large number of *Phog* (*Calligonum*) bushes in the vicinity cleared without finding any. Dense thorn fences in the neighbouring cultivated fields were lifted up and, though a few Acridids such as *Anacridium* and *Cyrtacanthacris*, were found hiding underneath, no specimens of the Desert Locust were noted. Similar search in other localities of the Thar area met with the same results.

Had locusts been really in hiding in these areas in order to escape either the cold or the drought, they should have emerged with the general rise of temperature in spring, or after the receipt of rainfall during February, 1935, or later on in April, but none were found. In view of the circumstance that in the areas examined numerous specimens had been noted in October and November 1934, one is led to the conclusion that the disappearance had evidently been due to an emigration.

*Breeding in the Winter-Rainfall areas.*—With the prevalence of drought in 1934, breeding was completely absent in the Mekran Coastal areas. With the receipt of rainfall in December, locusts were found to re-appear in fair numbers on the reks. The first eggs were probably laid as early as January, and the first hoppers were noted early in March and the first adults of the new generation were noticed early in April. Breeding continued on the general reks till the end of May. In Kolwah, the Fieldman found a few V-stage hoppers in April, which indicates that breeding had started rather early there. In Kulanch also, e.g., at Kandasale, green hoppers were found in some numbers in April.

In May, hoppers were found in Kulanch, as also at Mand in the Kech valley. In June, while few hoppers were to be found on the coastal reks, excepting the hoppers on the Pasni special areas, hoppers of all stages were found in 3 different localities on wild plants growing on the beds of streams in Kulanch and Daslit. Presumably these hoppers represent the second generation of the season produced by the adults emerging in April.

In regard to the colour of hoppers, green was the usual colour met with. During May, several cases of hoppers of brown colour with darker patches were met with both at Pasni and in Kulanch. Presumably, these might be taken to be forms of the *transiens* type.

#### *Reports of Gregarious Hoppers in Mekran and Kharan.*

1. *Shashtal area in Kech Valley.*—The Turbat Fieldman was informed about the 14th June by the Naib of Turbat that crops at Shashtal near Nodez were being attacked by bands of hoppers, and under instructions from Pasni he visited the area about the 17th June. He was informed by the owner of the field that "about 40 days previously bands of black hoppers, hatched on the adjoining sandy reks, had entered his field of *Jowari* (*Sorghum*) and pulses, and had been damaging the crops. The hoppers had later on turned yellow in colour, and ultimately had disappeared after acquiring wings about 10 days ago." The Fieldman further reported that at the time of his visit he noted "about 400 adults within an area of 800 sq. yards", as also a number of yellowish hoppers on the crops. At the same time he also noted the presence of

several green hoppers on wild plants, and of greyish adults in the sandy areas in the neighbourhood. Assistant Mr. R. N. Batra visited this area about the 6th July, and could then find only about 33 adults in that field.

2. *Sehgazan-Gar area near Panjgur*.—On the 22nd July, a report was received from the Naib-Wazir-i-Azam, Mekran, from Camp Pasni, to the effect that the Naib of Panjgur had noticed an infestation by locusts in *Jowari* cultivation at Sehgzan and Gar on the 7th July. The area was examined by the Turbat Fieldman on the 12th August, when very few locusts could be seen. According to his report, "the cultivators had encountered about two months ago, a 'flood' of black hoppers entering the crops from the banks of the Rakshan and Gwargo respectively, and damaging them." At the time of the visit of the Janishin, Panjgur, both hoppers and locusts were to be found. All the hoppers had since turned into adults, which disappeared about the middle of July when the "Gorich" or the dry wind from the north began to blow over the area.

3. *Washuk area in Kharan*.—The Nawab of Kharan reported to the Political Agent, Kalat about the occurrence of locust hoppers at Balgattar and at Macho in the sandy desert near Washuk at the beginning of July. Information was later on obtained from the Nawab to the effect that the hoppers had been killed by the intense heat of the desert sands, though perhaps they had, in reality, dispersed among the scattered vegetation and were lost sight of.

These reports raise the question of the origin of these infestations. In the first two cases, it is specially stated that no swarms, to which they could be traced, had been seen in these areas. In the Shashtal infestation, it is probable that eggs had been laid about the middle of April, while in the Sehgzan-Gar one, and possibly also in the Washuk case, oviposition had occurred early in May 1935. During the tours carried out by the Turbat Fieldman, in Panjgur-Kech-Kolwah areas, locusts were not met with during January, February and March, 1935, but were encountered in fairly good numbers in April and May. This circumstance rather suggests that a migration of the solitaires of the coastal areas—possibly of the new generation adults and perhaps of some of the old generation ones as well, had occurred during April, as by that time surface moisture on the Coastal reks had mostly dried up, while in the Mekran hinterland moisture was available on account of recent falls of rain. Since in the interior of Mekran, which is to a large extent either hilly or stony, places suitable for oviposition are few and are restricted to sandy mounds on the banks of rivers or sandy patches at the base of the hills, or the sandbeds of hill streams, it is possible that a concentration of solitary phase migrants had occurred at the time of egg-laying and had led to mass-oviposition on a small scale. After hatching the hoppers must have undergone a compulsory crowding in the patches of *Jowari* cultivation nearby. In all cases, the resultant adults are reported to have disappeared after acquiring wings. Except in the case of Nodez (Shashtal), specimens of locusts could not be collected from the places of report, but even at Nodez the specimens collected were those of the remnants after the main body had departed, and these showed mostly ratios of the solitary type.

These three cases are of special importance from the Locust Research point of view, especially in view of the fact that they had occurred just prior to the wide-spread locust incursion noticed in many parts of N. W. India in July. If the assumption made as to the origin of these infestations from migrant parents of the solitary phase type should be correct, these cases should be considered to be actual instances of the transformation of the *solitary*

phase into the *gregarious* or, in other words, the localities where this had occurred should be regarded as the real *outbreak centres*.

In this connection, it may be recalled that in 1923—a year of early rainfall, an outbreak centre of this character developed at Zarenbug and Hasadi in the Dasht area, and in 1926—the year of the great locust invasion of India, similar outbreak centres were found in the Kulanch area. It is significant that, in all these cases the time of development was May-June, denoting that the second brood of the winter-rainfall regions was always concerned.

*Distribution of Locusts in May and June.*—By June, it was apparent that the locust population of some parts of the Pasni reks had decreased. At the same time, it was observable that locusts had begun to reappear in the summer rainfall areas. At Ambagh two specimens were found in May and quite a good number in June. Similarly at Chachro, the first locust of the season was noted on the 17th May and two more later on in the same month; and in June, a fair number had been recorded during surveys. At Barmer the first specimen was noted only on the 8th June, but a good many later on. At Nokh, the first locust was observed on the 29th May, while at Sardarshahr, the first one was noted only on the 25th June.

At Ambagh, the specimens collected in June were found to have either hyaline or slightly yellow wings and were clearly, therefore, of a recently fledged generation. As there was no breeding anywhere near Ambagh, it is apparent that they were migrants from the western areas—either Pasni or Ormara, and this view was somewhat strengthened by the fact that many of those locusts had rather bright blue stripes—a colouration found common among many locusts of the new brood noted in May at Pasni and Ormara.

On biometrical examination, it was found that almost all the locust specimens collected in May and June, and upto 10th July, whether at Ambagh, or Chachro or Barmer, possessed E/F ratios of either the solitary or the intermediate type. In fact, the majority showed ratios below 2.05.

It is, therefore, surmised that those locusts constituted the first wave of migration of the non-gregarious type of locusts produced in the Mekran coastal reks. It may be recalled that in May-June, 1931 also, locusts appeared more or less suddenly after a period of disappearance lasting from December to April, and this is presumably an instance of the same phenomenon.

*The Locust Incursion of July 1935.*—At the beginning of July, the general locust population on the various reks at Pasni varied from 50 to 500 per sq. mile, and it looked as if the density of population would further decrease, when all on a sudden a perceptibly large accretion of population took place from the 12th July onwards, especially on the northern reks. After a careful examination, it was found that the rate of population was considerably over 5,000 per sq. mile. The presence of numerous forms of pinkish colour and possessing pinkish hindwings, and of a few of bright yellow colour made it abundantly clear that the rise of population was due to an immigration from outside. While the locust forms noted prior to this event were mostly solitary in their Elytron/Femur ratios, the new migrants showed all ratios ranging from 2.00 to 2.30, the majority being, however, of the intermediate type, i.e., from 2.06 to 2.15. In the course of local surveys at Pasni, it was found that the population fluctuated greatly on account of local migrations. For example, for some time during August the southern or coastal reks of Pasni showed the highest concentrations, the rate rising upto 48,000 per sq. mile in restricted areas. After the middle of August, the locusts on the reks gradually diminished in numbers, and the density of population was hardly above 1,000 per sq. mile during October. As the natural enemies of the adult

locusts are not sufficiently numerous on the Pasni reks to account for the remarkable diminution in the population, it is possibly to be attributed to migration elsewhere. There being no rainfall at Pasni in summer this year, there was no general breeding during summer. It may also be stated that all the migrants—whatever their E/F ratios, had developed by September, a general colouration of the *solitaria* type with prominent stripes and striped eyes; and a similar phenomenon was noted at the same time on the Ambagh reks also.

It was remarkable that such an increase in population occurred not only at Pasni, but at the same time and almost on the same date at Gwadar, Ormara, Ambagh, Chachro and Barmer, and various places in Sind and Kachhi. It is noteworthy that in none of these places, the passage of swarms had been noticed. On the other hand, in the Jaisalmer area, the Hakim of Shahgarh reported a swarm flying south to north over Shahgarh as early as the 1st July 1935, and at Rcti (Bahawalporo State), Public Ways Inspector, N. W. Railways, Khanpur reported having seen a swarm flying S. E. to N. W. on the 4th July. In the Khairpur State, a few swarms were reported on the 19th and the 29th July, and also some in north Jaisalmer.

As to the origin of this incursion, it is difficult to make any statements, except that it had presumably originated from the direction of the interior of Mekran. Possibly some of the infestations reported at Shashtal, Sehgasan, Gar and Washuk had contributed to the numbers of this incursion, but it is almost certain that the greater part had had an origin outside Mekran, possibly in Persian Baluchistan and perhaps in the coasts of Eastern Arabia, as there had been plentiful rainfall in these areas also this year.

*Breeding in Summer Rainfall Areas.*—No breeding was noted anywhere in Jashela or the Sind-Rajputana area during the spring months, in spite of a certain amount of rainfall.

With the first fall of rain in the 2nd week of July, breeding was set on foot in the desert areas of Thar-Parkar, Mallani, Bikaner and Jaisalmer. In view of the advent of the locust incursion, the problem of the summer brood assumed an added importance, for, in case a bulk multiplication of the migrants were to occur, there was the likelihood of regular swarms being produced and a new cycle of locust infestation being inaugurated.

I-instar hoppers were first noted on the 28th July in parts of the Thar-Parkar District, and were found during August in most parts of the Rajputana Desert area. The first adults of the new generation were noticed at the end of August at Chachro, Nokh, Sardarshahr and Barmer. A few of the new generation adults collected at Chachro in the 3rd week of September had yellowish wings and a female was found to have fairly mature eggs.

Hoppers continued to be found till the 6th November at Chachro and in certain other parts of the Thar area till the 17th November; and at Barmer till the 27th October, and in certain parts of the Mallani area till the 15th November. It is presumed that the hoppers noted in October-November were the progeny of the new generation of adults produced in August-September, the oviposition having occurred after the rainfall of mid-September. This probably indicates that in case heavy rainfall had occurred in September there might have been a further multiplication of the locust in the Indian Desert area.

At Mohangarh in the Jaisalmer State, and in the vicinity of Kantio near Chachro, rumours had been prevalent that oviposition by swarms had occurred in July and that black hoppers had subsequently hatched out, but there has

been no confirmation of these reports and gregarious hoppers were not noted anywhere.

A series of specimens of the new generation produced at Chachro and Barmer in September and October, were examined by Mr. D. R. Bhatia and myself and it was noticed that most of them possessed either *solitary* or *intermediate* elytron/femur ratios.

In the *Lasbela* area, there was no appreciable rainfall this summer, and consequently no general breeding was observed.

*Distribution of Locusts in the Autumn.*—With the withdrawal of the monsoon in the third week of September, the Rajputana area became an area of low humidity and fairly high temperatures. It is presumed that this change had had the effect of initiating locust movements tending to drive them out of the Rajputana area. In these movements, the change in the direction of the wind towards a north-east trend, which started about the 10th October, had probably played a great part.

At Sardarshahr locusts were not to be seen after the 24th October; while at about the same time, Nokh experienced an increase of population, and further west, large concentrations of locusts were noted at Lathi and Choyan about the 20th to 22nd October. Subsequently the locust population at Nokh decreased gradually, and ultimately none were observable during surveys after the 22nd November.

Similarly in the Barmer area, the population gradually decreased in number during November, while to the west at Chachro the relative density somewhat increased about the same period, though towards the close of November numbers had greatly diminished.

At Ambagh, Mr. Batra noticed, towards the middle of October, the presence during surveys of certain specimens with hyaline or mauve wings. The proportion of these forms gradually increased, till by the end of November, the hyaline or mauve forms far outnumbered the rest. Similar hyaline-winged forms have been found in October-November in the Hingol and Ormara areas. During the last week of November, fairly good numbers of these forms were noted on the Pasni reks also. The influx of population in the western areas, when coupled with the efflux of the new generation out of Rajputana would appear to bear evidence to a seasonal migration of the solitaries from the summer rainfall areas to the winter breeding grounds on the Mekran coast.

*Migration of the Solitaries.*—During the present year, a certain volume of evidence has accumulated in regard to the existence among the solitary forms of powers of migration similar to those exhibited by the *gregaria* forms during years of infestation. Although the data of previous years had rather vaguely indicated the probability of migration among the solitary locusts, there were no definite proofs in the matter. At the time of the July incursion this year, concrete evidence was obtained as to the capability of *Schistocerca* to migrate to a distant area by way of an imperceptible flight of individual locusts as contrasted with a migration of massed swarms. In fact, at the time of the incursion, neither the event nor the consequent increase in the locust population had been noticed by the people in most localities, and quite possibly, the event might have remained undetected, had it not been for the activities of the Locust Survey staff stationed in the various areas.

The data collected on the subject may be classified as follows :—

1. *Inductional Evidence.*—(a) As already explained in the previous paragraphs of this report, a definite fluctuation of population has been noticeable in the areas of habitat of *Schistocerca*. In winter, locust population

gradually diminishes almost to the vanishing point in most of the areas of the summer brood, such as the Thar area, South Marwar, Bikaner etc., while at this time the population is augmented in the winter brood areas, such as the Mekran reks. Breeding also occurs at this time and the population multiplies. On the other hand, in summer, the locust population decreases gradually on the reks, whereas they re-appear in the Indian Desert areas and multiply by breeding during the monsoon months. The two areas look as if they are complementary to one another, and the facts can be interpreted only by postulating a mutual exchange of population between the two areas according to the seasons.

(b) An intensive survey of the different centres and the biometrical study of specimens collected at different seasons has disclosed the fact that very often there is a change in the character of the forms. The July incursion of this year was found to be characterised by the preponderance of intermediate and gregarious forms, while during the autumn and winter months, the *solitaria* type has been predominating, and *gregaria* has disappeared. The occurrence of such a replacement of forms at a time when local breeding had not occurred can only be explained by the phenomenon of migration.

2. Direct Evidence.—(a) *The Powers of High-flying of the Solitaries.*—The ability of the *Solitaria* individual sometimes to rise high into the air and vanish from sight has been noticed by the locust survey staff at different times, but its significance was not realised till the time of the July incursion. During this period, locusts were in numerous instances observed to rise high into the sky and disappear, often without any apparent provocation. During July, this was noticed to occur sometimes at dusk and sometimes at mid-day. The height to which the locust rose could not be accurately estimated, but it must have been over 500 feet at least above the level of the ground. The direction of the flight was generally governed by the prevailing wind-direction at the time, but it was clear that the locust did not drift passively with the wind. Such instances of high flights were noticed not only at Pasni, but also at Chachro and Ambagh. There is apparently little doubt that the long distance migration of the *solitaria* individual is greatly dependent on the strength and direction of the prevailing winds at the time.

(b) Since February, 1935, a system of marking locusts collected during the periodical surveys and liberating them was tried at Pasni. At the beginning, marks indicating the month of liberation were made with cellulose paints on the pronotum of the locust, but it was generally found that the paints peeled off after some time. Later on, painting the hindwings was tried, but in this case also there was a similar result if the paint was applied thick. At present a system of lightly painting the figure of the month in arabic numerals on the wings is in practice at Pasni. In order to signify the time of marking more exactly, the left wing is being painted during the first fortnight of the month, and the right wing during the second. In addition a bit of coloured silk thread is tied at the distal end of the femora in order to facilitate their being spotted easily in the field. A similar system is now being adopted at Ambagh and the various desert Outposts, different colours being adopted by each station:—Blue for Pasni, red for Ambagh, green for Chachro, white for Bermer, black for Nokh and yellow for Sardarshahr. The cellulose paints could not be obtained early enough to try the system on an extensive scale this year.

Although marking locusts has been under trial at Pasni since February it is only in three instances that recoveries have been recorded. (1) A locust painted white in February was captured in March not very far off from the

place of liberation on the Pasni reks. (2) A locust painted red on the hindwing and liberated early in May was found by the Ormara Fieldman at Rumra about 20 miles to the N. E. from Pasni. on the 17th May. (3) In the third case, a locust painted blue on the hindwing and let off in June was found within a furlong from the Locust Camp early in July. The second case appears to be very significant.

In working out any system of marking and liberation, its success would be dependent on the possibilities of the recovery of the marked forms, for the areas under observation by the survey staff are comparatively limited, while the distances which the flying locusts could cover are enormous.

*Number of Generations in the year.*—In the Mekran Coastal areas, there was apparently only one generation in the year, excepting of course the special breeding areas of Pasni, where hoppers were found almost every month, between March and November. The hoppers found in Kulench-Dasht in May-June, and in Kech-Panjgur area in June-July are apparently to be regarded as the II generation of the year.

In the summer-breeding areas, oviposition began in July and the first adults of the new generation appeared at the end of August. Since hoppers were found in parts of the desert as late as the 17th November, they should be regarded as representing the second generation of the season. If it should be permissible to consider the locusts of the July incursion to be the adults fledged from the second generation hoppers of the winter-rainfall areas, *Schistocerca gregaria* may be regarded as having at least partially gone through four broods during the year in the Indo-Persian region.

*Other Locusts.*—1. *Locusta migratoria* ph. *solitaria* was as in previous years met with in all the areas in small numbers.

2. *Patanga succincta*.—Two specimens of the Bombay Locust were collected by the Fieldman on the 27th January at Virawah and one at Harrah on the 30th January, both being within the Thar-Parkar District, but at the edge of the Runn of Cutch. One more specimen was collected on the 12th February at Dhorimana in the Mallani area.

#### IV.—Ecological Studies.

1. *Meteorological and Bio-climatic Observations.*—The results of the meteorological and bio-climatic observations made during the year at Pasni, Ambagh, Chachro, Barmer, Nokh and Sardarshahr are given in Statements F-1, F-2, F-3, F-4, F-5, and F-6 respectively. A comparative glance at the results would give us a general idea of the climatic conditions of the different stations.

(1) *Rainfall.*—Pasni is the only station which falls in the regular winter-rain zone, while the rest come under the influence of the Indian monsoon in summer. Pasni received about 11.60 inches in winter, while Ambagh received 3 inches in all during the winter and spring, but almost none in summer this year. The desert stations received a fair amount of rainfall this year during the monsoon months.

(2) *Temperature.*—At Pasni and Ambagh, which come under the tempering influence of the sea, the variations of temperature have been moderate throughout the year. Any sharp rise or fall of temperature has generally been due to the temporary setting in of the dry land-winds. On the other hand, in some of the desert stations temperature rose as high as 117° F. in May-June, while during the cold wave records as low 20° F. were noted.



(3) *Humidity*.—Both at Pasni and Ambagh, humidity is generally high except for short periods in October or whenever the dry land-breeze "Gorich" blows. Humidity is specially high during the period from April to September when the south-west wind from the sea—the "Shemal", blows almost constantly especially during the afternoons. In the desert stations, the humidity is comparatively low at all times of the year. A rise occurs only when the monsoon current is established, and in October when the monsoon retreats the fall of humidity is rather sudden, and the Rajputana area becomes for the time being a zone of the lowest humidity in North India.

*N.B. Pasni Research Station*.—Various new instruments ordered for the station through the Agricultural Meteorologist, Poona, have not yet been received. When the set is complete, detailed observations would be started with the advice of the Agricultural Meteorologist. A new meteorological station will be laid out near the new buildings fenced as per plan kindly furnished by the Agricultural Meteorologist.

2. *Vegetational Studies*.—Beginnings have been made in all the stations in regard to the recording of the typical vegetation of the area by the Plant Quadrat method.

Collection of the Flora was continued in all the stations and a special collection of the annuals appearing at Pasni after the rains was made in February-March by Dr. Karandikar.

Observations have also been made as far as possible in regard to plants preferred as food by hoppers in all areas.

3. *Locust Breeding*. (i) *Pasni*.—There were heavy falls of rain at Pasni on the following dates: 22nd December 1934, 8th January 1935, 27th and 28th January and 2nd February, after which there were good showers amounting in all to 1.50" on the 10th, 11th and 12th February. The total rainfall for the season was 11.00".

Locusts were found on the reks soon after the first showers of rain in December. Judging from the age of the hoppers collected in March and from that of the first adult of the new generation noticed on the 8th April, it is surmised that the earliest hatching must have occurred about the 25th February, and taking the temperature data for January and February into consideration, it is considered probable that the earliest egg-laying occurred during the warm spell of December lasting upto the 10th January before the onset of the great cold wave of the 12-18 January.

On the general reks, hoppers disappeared by the end of May, though in the special areas, hatching continued till the 15th October and the last hopper was noted as late as the 19th November.

(ii) *Ambagh*.—There was considerable rainfall in January, February and April amounting respectively to 0.93", 0.78" and 1.58". During the monsoon period, the falls were 0.38" in July, 0.08" in August, 0.05" in September, and 0.06" in October.

Breeding was observed neither in spring nor in summer. A single specimen of a green hopper of the V-instar was, however, collected near Naka Kharrari on the 5th October, and may presumably have been the result of a stray oviposition after a local shower in August.

(iii) *Chachro*.—There was no spring rainfall except for a shower in January. During the monsoon, 7.89" was recorded during July, 2.47" in August, 0.49" in September, and 0.50" on the 30th October.



The first hoppers were collected on the 2nd August, but the earliest hatching had probably occurred about the 25th July and the earliest oviposition about the 10th July soon after the first falls of rain. The first adult of the new generation was collected on the 31st August.

The last hopper to be seen was one V-instar one collected on the 6th November, and may be presumed to represent the second generation of the season.

Very similar data were recorded at Bariner, Nokh and Sardarshahr Outposts, as the conditions were on the whole identical.

It was stated in last year's report that, in view of the fact that breeding had not occurred throughout the year whether at Pasni or at Gwadar, and also in view of the circumstance that a few locusts were noted at Gwadar till October, "it may be surmised that the longevity of an adult locust may extend upto 15 months". In view of the powers of migration possessed by the locust, and in view of the results of a biometrical examination of some of the 1934 specimens of locusts from Pasni, (shown in Statement K-2) the statement made on the longevity of the locusts lacks confirmation.

4. *Natural Enemies*.—Some attention was paid to observations on the natural enemies of the Locust at Pasni, Ambagh and in the Desert areas. Some of the specimens have not yet been identified.

(1) An Asilid fly was found attacking I-instar hoppers at Pasni in August.

(2) Certain spiders were observed attacking young hoppers in the field.

(3) Four different kinds of lizards were found predaceous at Pasni :—

1. *A scinc (Mabuya sp.)*.—A V-instar hopper was found in the stomach on dissection.

2. *A lizard (Eremias sp.)*.—Hoppers of I, II, and III-instar were found among the stomach contents of several young specimens.

3. *Blood-suckers*.—Probably *Calotes* and *Agama* : hoppers found in the stomach.

(4) *Predatory Birds*—

The Indian Roller, the Bee-eater, and the Shrike were common at Pasni and found attacking adult locusts.

The King-crow, the Babbler, a hawk, the Starling, etc. were found at Ambagh and in the Desert areas.

## PART II

### EXPERIMENTAL STUDIES ON THE LIFE-CYCLE OF THE DESERT LOCUST AT PASNI

Before giving an account of the experimental work done at Pasni this year, it may be stated that the work was done in the face of many handicaps, chiefly on account of the non-availability, at different parts of the year, of sufficient hands to look after the various items programmed.

The following experiments were undertaken during the year :—

1. *The Number of Generations during the year under semi-natural conditions* :

2. *The Influence of the Quality of Food on the Sex-maturation of the Locust :*
3. *The Length of the Incubation and Larval periods under semi-natural conditions :*
4. *Observations on the Rhythm of Locust Activity during the different seasons of the year :*
5. *Observations on the Special Areas of the Pasni Reks :*

I. *Number of Generations in the year.*—It may be stated that during the last two years, the experiment was started in September of the year previous with a pair of locusts of known age, and the succession of generations from this pair was followed under rearing in cages kept in the open subject to the natural conditions of the rek, except for a regular supply of food and for the provision of moist sand at the bottom of the cage for egg-laying. The cage started in September, 1934 appears to have proved a failure. Locusts re-appeared on the Pasni reks only by the end of December 1934, and the experiments for the current year could not be started until the first hatchings took place in the Field cages in February 1935 after the inhibitive effect of the cold wave of January had disappeared.

Owing to the delay in starting the experiment, only three generations have been followed between February and November 1935 :—

*First Generation.*

Earliest date of—

Oviposition . . . . .	Prior to 9th February 1935	} Over 35 days.
Hatching . . . . .	14-iii-35	
I moult . . . . .	21-iii-35	} 43 days.
II moult . . . . .	29-iii-35	
III moult . . . . .	6-iv-35	
IV moult . . . . .	16-iv-35	
V moult (Adult) . . . . .	26-iv-35	

*Second Generation.*

Earliest date of—

Copulation . . . . .	27-v-35	}	16 days	}	40 days.
Oviposition . . . . .	31-v-35				
Hatching . . . . .	15-vi-35	}			
I moult . . . . .	?				
II moult . . . . .	? Not noted	}			
III moult . . . . .	?				
IV moult . . . . .	14-vii-35	}			
V moult (Adult) . . . . .	25-vii-35				

*Third Generation.*

Earliest date of—

Copulation . . . . .	20-viii-35	} 17 days	} 56 days.
Oviposition . . . . .	28-viii-35		
Hatching . . . . .	14-ix-35		
I moult . . . . .	22-ix-35	}	
II moult . . . . .	30-ix-35		
III moult . . . . .	10-x-35		
IV moult . . . . .	23-x-35		
V moult (Adult) . . . . .	9-xi-35		

Though incomplete this year, the results are of value, as it is clear therefrom that, given the conditions necessary for breeding, three generations may readily follow one another on the rek areas. This inference is clearly illustrated by the fact that breeding has been continuously in progress on the special areas of Pasni, hatching having been found to take place up to the middle of October.

It is rather unfortunate that the winter generation has not been represented in the current year's experiments, as the results should have been of value in interpreting the data. Rains arrived early by the second fortnight of December, and there were heavy falls also during the first week of January, and the general temperature conditions were favourable for breeding till the 10th January, being about  $20^{\circ} \pm 5^{\circ}$  C. In fact, locusts were found pairing in the field cages and also found attempting to oviposit. With the appearance of the cold wave, 12th to 18th January, conditions became entirely unfavourable for breeding. In the warden cages, the majority of locusts succumbed to the cold, and there must have been a set-back in nature too. The collection of a IV-stage hopper on the 25th March, and of a V-instar one on the 30th March, as well as the appearance of a new generation adult on the Pasni reks on the 8th April indicate that hatching must have occurred as early as the last week of February. Taking into account the unfavourable climatic conditions that prevailed after the cold wave, it appears not improbable that egg-laying had taken place as early as the first week of January. Valuable corroboration might have been obtained from the winter phase of the generation experiments.

It had been proposed to rear all the hatchlings of the generation experiments, as far as feasible, in order to get an idea of the actual capabilities of multiplication of *Schistocerca* under favourable conditions, but for various reasons, this item could not be undertaken. It is proposed during the ensuing year to set apart one or two of the field cages for this experiment.

It would perhaps be useful if the generation experiments could be undertaken at Ambagh and also at one or two of the Desert Outposts.

II. *Experiments on the Quality of Food on Sex-maturity.*—In the 1934 Report for Pasni, it was shown that in several cases, locusts kept in cages with dry soil at the bottom but fed on fresh shoots of Marrand (*Heliotropium undulatum*) showed signs of sexual maturity sooner or later, and in many cases dropped eggs on the soil surface in the cage, though, in the open reks none of the locusts were found to be sexually mature, owing presumably to the parched condition of the vegetation during 1934.

As per suggestions made by the Locust Committee, detailed experiments were devised during the current year to test the effect of feeding locusts on fresh Marrand shoots as against partially dried old shoots, and also on different natural food-plants, such as 'Kullichk'—a sedge, (*Cyperus arenarius*, Retz), 'Mazoung'—(*Sphaerocoma hookeri*, T. And.), 'Balibur'—(*Acrua javanica*, Juss.), and 'Kharzan'—(*Sericostoma pauciflorum*, Stocks) and a cultivated plant such as 'Jowari'—(*Andropogon sorghum*).

Wire-gauze cages—1 ft. by 1 ft. by  $1\frac{1}{2}$  ft.,—with a movable platform at the bottom, provided with holes through which tubes of sand could be inserted for egg-laying, were employed for these experiments.

In the experiments tried, locusts were fed on the following foods :—

I. Fresh shoots of Marrand.

II. Old shoots of Marrand : (*i.e.*, shoots in which most of the leaves except a few at the tip were dried up).

- III. Old Marrand shoots—Wetted : (i.e., the shoots were dipped in water occasionally, so as to supply the water deficiency of dried leaves).
- IV. Old Marrand with Moist atmosphere : (A moist atmosphere was sought to be created by keeping wet sand under the wire-gauze platform).
- V. Fresh shoots of Kullichk (*Cyperus arenarius*).
- VI. „ „ „ Balibur (*Acrus javanicus*).
- VII. „ „ „ Kharzan (*Sericostoma*).
- VIII. „ „ „ Jowari (*Andropogon*).
- IX. „ „ „ Mazoung (*Sphaerocoma*).

In regard to the term 'Old Marrand', it may be stated that '*Marrand*' (*Heliotropium undulatum* Vahl.) is a plant adapted to sandy deserts. It possesses a single tap-root, which may reach a depth of 5 to 6 ft. from the surface, and may reach laterally a distance of over 15 ft. from the plant. Under ordinary conditions, the plant is able to keep green and put forth shoots and flowers throughout the year, as it can draw upon the moisture in the deeper layers of sand. In years of drought, the plant is unable to tap sufficient moisture, and the shoots appear more or less dried up. During May and June 1935, the plants were so green that it was found difficult to get shoots sufficiently dried up for the experiment.

In the case of 'Mazoung', it was soon found that locusts did not feed much on it, and as 3 females died in succession after a week each, this food plant was discarded for the experiments.

In these experiments, a male and a female were introduced into a cage soon after their reaching the adult condition, and were examined periodically, especially for noting the colour of the hindwings. It was observed that in newly fledged specimens, the hindwings are hyaline in colour. In the course of a week or more, a yellowish tinge was found to appear on the wings, which gradually deepened in the course of another week or 10 days. The yellow colour would appear to be a symptom of the onset of sex-maturation, as at that stage the male was found to make its first attempts at courtship. By the time oviposition takes place, the wings have assumed a bright yellow colour. When eggs have been laid several times and the insect's vitality is on the wane, a dull orange yellow colour was usually found to supervene.

In recording the results of the experiments, therefore, the appearance of the yellow tinge had been taken as the first landmark indicating the onset of sex maturity, though the data of first oviposition would be the final criterion.

For various reasons, it was not possible to begin the experiments earlier than May. They have now been in progress for over six months, covering the summer and the autumn seasons, and as may be expected the difference of the climatic conditions has had its effect on the results. The data obtained have been classified according to the seasons, and separate averages have been struck as far as possible. (See Statements G-1 and G-2). As, however, the results for the autumn set are not yet fully available, a comparison has been instituted, on the basis of the summer results, as per statement shown below

and though it is too early to come to any definite conclusions, the general trend of the results indicates the importance of the subject.

Serial No.	Nature of Food	Time taken for the development of yellow tinge in the wings	Time taken for the first oviposition	Average temperature for the period from May to August 1935.
		(In days)	(In days)	
1	Jowari . . . . .	16.75	22.5	
2	Fresh Marrand . . . . .	17.16	35	
3	Kullichk . . . . .	21.5	38.2	
4	Old Marrand with moist atmosphere.	23	45	
5	Balibur . . . . .	24.7	49	
6	Old Marrand . . . . .	25.5	52.4	About.
7	Old Marrand Wetted . . . . .	26.7	52.7	28° ± 4°C.
8	Kharzan . . . . .	23.6	59.5	

The results obtained so far appear to indicate that Sorghum (Jowari), Fresh Marrand and Kullichk are definitely superior to the other foods experimented with, which are more or less on the same level.

In case future experiments should confirm the capacity of Jowari in quickening up sex-maturation, the fact may prove to be of great significance. In fact, in the two cases of incipient swarm formation reported from Mekran, the hoppers were found attacking the Jowari crop.

Although Kharzan has not yielded any results, it may be stated that it is one of the preferred food-plants of the Locust. At Ambagh, Marrand is scarce and its place is taken by Kharzan, and it has been arranged to have the experiment repeated at Ambagh with young shoots of Kharzan. It may be added that Kharzan is found only in the Adasti coastal reks at Pasni and is generally stunted in growth owing to over-grazing.

*Balibur* or 'Booh' is one of the most common food-plants of the Locust in the Rajputana deserts, but it is eaten only when the plant is young and tender. When the plants are grown up, they are deserted by the hoppers for other food-plants such as certain common species of *Indigofera*. The poor results obtained may perhaps be due to the fact that tender *Balibur* was not always available for feeding at Pasni.

In future experiments, the water contents of the plants fed would be determined, so as to have definite data for comparison.

III. *The length of the incubation and larval periods under semi-natural conditions.*—As in previous years, temperature records were kept for all hatchings, and rearings. The moisture percentage of sand at 4" depth was about 4 per cent. Most of the recorded data are summarised in Statement H, and serve to demonstrate the effect of the meteorological conditions of the different seasons on the length of the incubation period.

No attempts were made during the year to correlate the colour of the hatchlings with other data:

In previous years, the sex-ratio of the progeny had been worked out after the adult stage had been reached, but as a high percentage of mortality usually intervenes during the period of rearing, the ratios thus expressed are of no value. Since July 1935, a system of determining the sex-ratio of each batch of hoppers soon after hatching has been adopted, and the results included in the statement. The sex-ratio may prove to be of value in studying the factors leading to the mass-multiplication of *Schistocerca*.

Statement I shows the relative effect of the seasonal conditions on the length of the post-embryonic period.

IV. *Rhythm of Locust activity*.—During the year under report, special attention was paid to observations on the daily rhythm of the solitary phase of the locust under the semi-natural conditions of a large compartment—16½ ft. by 16½ ft.—of one of the field cages. The observations were made by Dr. Karandikar during December 1934 and February 1935, and by Mr. A. C. Sen during January 1935, mostly on adults. During April-May, notes in regard to both hoppers and adults were taken by Mr. Taqi Ahsan, and during September-October observations were made on green hoppers actually in the field by Mr. Taqi Ahsan.

By May, 1935 all the field cages had, unfortunately, been over-run by ants—*Monomorium salomonis indicum*—which killed a great many of the encaged locusts. As attention had to be focussed on preventing their inroads and as many of the locusts had been killed, observations had to be discontinued. Subsequently the cages were dismantled for being transferred to the vicinity of the new Pasni buildings, and the work on rhythmic activity had to be held in abeyance.

The observations recorded during the year as well as those of the years previous have been examined by Dr. Roonwal, and have been summarised by him as per statement given below. (attached.)

Further work will be under taken by Dr. Roonwal during the ensuing year and as far as possible they will be duplicated by observations made in the field.

V. *Observations on the special breeding areas of the Pasni reks*.—What have been termed as 'Special Breeding areas' viz., those in which I-instar hoppers have been noted almost continuously from March to October, would appear to fall under two categories :—1. Areas at the base of or between large bare sand-dunes, in which moisture percolating from the base of the dunes is brought to the surface on account of the presence of an impervious clay layer below the sand. Here the marram bushes are found to be fairly luxuriant. Instances of such areas are found at Gandakoh and Hadzai. 2. Areas on the sides and top of certain sand-ridges of the consolidated type, covered with bushes and other vegetation. Here though the surface layers upto 2 feet or more are dry, the interior has a store of moisture, which is tapped by the deep-rooted plants growing on the dune. On close examination, it was found that in the case of most of such dunes, there were always some places where by the action of the wind the surface sand is blown away, laying bare thereby the more moist layers. It is surmised that the locust finds out such places and deposits the eggs therein, and the hoppers after emergence will get scattered and become distributed among the greener bushes.

In order to test the possibility of such a happening, three pairs of locusts were confined within a small cage placed on the top of a dune in the Sadi Rek after duly protecting the cage from being blown off by the wind. In the course of a few weeks, two egg-masses were found laid by the females, which hatched out normally in the laboratory on transfer to a tube of wet sand. While laying the eggs, the female had bored through an inch and a half of dry sand to reach the moist layers below. No actual case of egg-laying or hatching in such locations has, however, yet been observed in nature.

### PART III

#### MISCELLANEOUS ITEMS : CONCLUSIONS AND SUGGESTIONS FOR FURTHER WORK.

I. *Locust movements in the year.*—Except for a few swarms reported at the time of the Incursion of Locusts in July-August, no locust movements on a large scale are known to have taken place within the limits of British India—

1. 11th March 1935 : (*Unofficial*).—The “Statesman” published on the 12th March, a telegram from its Ahmedabad correspondent to the effect that the standing crops of Dholka (in Guzerat) had been seriously damaged by a swarm of locusts following a heavy cyclone. The statement was not officially confirmed by the Collector, Ahmedabad.
2. 1st July 1935 : (*Official Report*).—The Hakim of Shahgarh (Jaisalmer State) reported that swarm passed over Shahgarh from south to north on the 1st July.
3. 4th July 1935 : (*Unofficial*).—The Public Ways Inspector, N. W. Ry., Khanpur informed Mr. Keshodas Baweja that he had seen a swarm flying S.-E. to N.-W. at Reti.
4. 7th July 1935 : (*Unofficial*).—Patel of Charnor, Chachro Taluka, Sind, informed Mr. D. R. Bhatia that he had noticed a small swarm of 200 locusts flying W. to E. at Charnor at 4 P.M.
5. 19th July 1935 : (*Official*).—Minister, Khairpur State reported that a swarm of yellowish locusts visited Akro and Muhananwari valleys in Faizganj Taluka on the 19th July. It came from the North-east flying low, and flew away eastwards the next morning. Locusts were seen pairing.
6. 29th July 1935 : (*Official*).—Minister, Khairpur State reported that a fairly large swarm of pink and yellow locusts was observed at Makan Dhundh in Faizganj Taluka on the 29th July. It came flying fairly high from the south, and only part of it alighted for an hour and then flew east-wards.
7. July 1935 : (*Unofficial*).—It was reported at Nokh that swarms had visited Khairuwala and Nowa, to the north of Jaisalmer State during July, and also that swarms had visited Mohangarh and laid eggs in July. No official confirmation.
8. July 1935 : (*Official*).—The Mukhtiarkars Chachro, Badin, Mithi and Jobi, and the Mahalkari, Thano Bulakhan reported the presence of large numbers of stray locusts in July in their areas.

It may be noted here that, except for the few reports from the Mukhtiar-kars in Sind, none appears to have noticed the considerable increment of locust population that had occurred during July and it appears very probable that the beginnings of the 1926 locust invasion of India had probably occurred more as an incursion of the kind that was noticed this year, than as a regular penetration in swarm formation.

II. *Study of old records.*—Owing to the shortage of staff, much work could not be accomplished. The chronological arrangement of the data accumulated was attended to. The mapping of the available data for Sind, Baluchistan, Rajputana and Western India States for the years 1926, 1927, 1928, 1929 and 1930 was attended to, and with the appointment of draftsman staff, the work of copying the maps was taken up.

The following records were obtained from the Assistant Secretary to the Financial Commissioners, Lahore for filling up certain lacunae in the information available in regard to the years 1896-1899, 1902 and 1918 and 1919.

(1) Punjab Government Annual Administration Reports for the above years; and

(2) Punjab Government Gazette Supplements for those years.

The data for the years prior to 1925 for the Punjab was studied by me personally and classified, as also the data for Baluchistan from 1908 to 1925. Data for the Bombay area was also studied cursorily.

III. *Correlation of Meteorological data.*—Data in regard to the conditions of temperature, humidity, direction and force of wind, etc. were extracted for all available stations in areas of East Persia, Baluchistan, and N.-W. India for July 1935 from the records of the Government Meteorologist, Karachi. It is proposed to plot out the data and study the conditions under which the July incursion of locusts had originated.

Data in regard to rainfall of various areas in 1933, 1934, and 1935 were also extracted.

IV. *Publications.*—A short article on 'Locust Research Work in India' was sent to "CURRENT SCIENCE" Bangalore, and was published in the July issue. A short note on the "Locust Position in North-West India and Baluchistan during the Current Year—1935" was sent to the Editor, "Current Science" at his request.

V. *Collections.*—Some batches of insects were sent to the Imperial Institute of Entomology, London and were received back identified.

Some of the Zoological Collections made during survey work and at Pasni were sent to the Indian Museum, Calcutta and some were received back identified as far as possible.

A large number of botanical specimens was sent to the Curator, Royal Botanical Garden, Sibpur, Calcutta, and was returned after identification. It is proposed to prepare a list of identified plants found in the desert regions along with their local names, for publication, as it would be very helpful in ecological work in connection with locusts.

VI. *Biometrical Study.*—A biometrical study of the locust collections made in the course of survey work during 1931 to 1935 was begun during the year. The work received added stimulus after the locust incursion noted in July-August, in view of the clues that biometrical values were found to furnish in the recognition of locust groups found at different parts of the year. The results of a study in regard to the locust population of the Pasni Reks during 1935 are tabulated in Statement K-1. It shows that the locusts that were



found on the reks after receipt of rains, and the adults of their progeny found in April-May were mostly *Solitary* or *Transiens* in their ratios, while the locusts found after the locust incursion showed mostly *Transiens* or *Gregaria* ratios. The specimens found towards the end of November were, on the other hand, mostly *solitary* in their values, and were found to possess hyaline wings indicating that they were a recently developed generation.

All the available collection of locusts found on the Pasni Reks during 1934, were also examined, and the results have been classified in Statement K-2. Biometrical studies have revealed the fact that in 1934 also, there had been an immigration of forms possessing *Transiens* or *Gregaria* ratios during the months of May to July, which is rather interesting in view of the circumstance that there was no breeding whatever on the coastal reks of British Mekran in 1934. Again, it has shown that there has been no continuity of population, as had been supposed formerly, so that the assumption that locusts could remain alive for as long as 15 to 18 months without breeding is not tenable. Some of the collections from the Rajputana areas of this year were examined, as far as time permitted, and it is likely that interesting information may emerge when the whole collection is gone through. During the year, Mr. Rashid Ahmad was appointed on the 27th August as Biometrical Assistant, but he had to be shifted to Pasni on the 1st September on account of the exigencies of the work there. As far as time permitted me, I personally attended to the measurements of all the collections examined at Karachi, while in regard to Pasni and Ambagh, it was arranged that every fortnight the collection made during the period under report should be examined in regard to the E/F ratios and the results submitted along with the periodical report.

VII. *Miscellaneous.—Pasni Buildings.*—The construction work was given to a contractor from Karachi, and the buildings are nearing completion.

*Field Cages.*—Four new cages 16½ ft. by 16½ ft. by 6 ft. with wooden frames were constructed, of which two were installed at Pasni, and the other two at Ambagh. The double compartment cages constructed last year were found too unwieldy for transference to new locations, and were split into four single ones.

*Distinguished Visitors at Pasni.*—The Vice-Chairman of the Imperial Council of Agricultural Research (Diwan Bahadur Sir T. Vijayaraghavacharya, K.B.E.) paid a visit to the Pasni Locust Research Station on the 24th April 1935, flying from Karachi by a Leopard-Moth Plane hired from the Karachi Aero-Club. He halted for a day on the 25th April at Pasni, and returned to Karachi on the 26th April.

The Assistant Political Agent, Panjgur and the Adjutant, Mekran Levy Corps, and the Naib Wazir-i-Azam, Mekran visited the Pasni Station during May 1935.

VIII. *Acknowledgments.*—I take this opportunity of acknowledging my indebtedness to the various authorities in Sind, Baluchistan, Rajputana, the Punjab States, and Punjab, and also the Darbars of Kalat, Lasbela, Bikaner, Jodhpur, Jaisalmer, Bahawalpore and Khairpur States for the ready help rendered to the Locust Survey staff during their tours in the areas under their jurisdiction. The thanks of the Imperial Council of Agricultural Research are specially due to the Durbars of Jodhpur, Jaisalmer, and Bikaner for allowing the opening of the Locust Outposts within their areas. My thanks are specially due to Dr. S. K. Pramanik, Meteorologist, Karachi for his courtesy and help in supplying various meteorological requirements in connection

with Locust Research work, and to Dr. L. A. Ramdas, Agricultural Meteorologist, Poona for advice in regard to the use of various meteorological instruments. The thanks of the Imperial Council are due to the Director-General of Observatories, India, Meteorological Department, Poona, for the loan of thermometers for use in the screens at Nokh and Barmer Outposts. I wish to express my thankfulness to Sir Guy A. K. Marshall, Director, Imperial Institute of Entomology, London and to Mr. B. P. Uvarov for identifying various lots of insects sent, and to the latter for sending me samples of cellulose paint and giving help in various other ways. My thanks are due to the Curator, Royal Botanic Garden, Sibpur, Calcutta for identifying several lots of plants collected in the desert areas, and to the Director, Zoological Survey of India, for identifying various zoological specimens.

In conclusion, I have to place on record the loss sustained by the Locust Research Scheme by the deprivation during the year of the services of four experienced hands who had been connected with the work almost from the commencement, viz.: Mr. Keshodas Baweja, M.Sc., Mirza Ahmad Ali Khan, Dr. K. R. Karandikar, Ph.D., F.E.S., and Mr. A. C. Sen, M. Sc. I wish to express my thanks to Mr. D. R. Bhatia for carrying on the work of both Barmer and Bikaner Circles single-handed for nearly four months, and to Mr. Taqi Ahsan for the splendid response he made this year in pushing through the experimental work at Pasni in spite of great handicaps.

IX. *Conclusions and suggestions for further work.*—The current year has proved to be a most eventful one from the point of view of Locust Research. There was early and plentiful rainfall all over the winter rainfall areas in Baluchistan and Iran. There was extensive breeding on all the Mekran Reks from March to May. Two reports of incipient swarming were received from Mekran, and thereafter a wide-spread locust incursion into India took place in July, which only narrowly missed starting a new locust infestation in N.-W. India by the shortage of monsoon rainfall. Lastly, clear evidence of the return migration of individual solitaries from the Rajputana area into the western reks in autumn has also been forthcoming.

Comparing the conditions under which the 1926 invasion came into being with those of the current year's incursion, it is seen that heavy and early rainfall also occurred in the western areas in 1926; similarly incipient swarms were formed in Kulanch in May-June 1926. Again, locusts are known to have appeared in the Mallani area in July, as during the present year, though regular swarms also followed later on. In 1926, on the other hand, the summer rainfall was extraordinarily heavy, and moreover continued late into September. Probably two generations of the Locust were produced in the desert area, the first in July-August, and the other in September-October. The first swarms of the year began to appear in October 1926.

Secondly, the evidence found in regard to the migration of solitary locusts if further confirmed, would show that there is not much difference between the *solitaria* and the *gregaria* phase in regard to the powers of migration. The difference would be only in the aggregation of numbers. We cannot now speak of either the western reks or the desert areas as the exclusive areas of habitat of *Schistocerca*. They should be rather considered to be complementary to each other.

Thirdly, in devising measures for the destruction of the locust in its breeding grounds, it would appear to be rather futile to attempt to deal with it, while breeding as a *solitaria* form in the coastal breeding grounds. One should rather look for the outbreak centres, where the increase in numbers and the transformation of phase occur. In the winter breeding areas, such

concentrations of the second generation would appear to occur in the interior, either in Kulanch, or Dasht, or in the valleys of Mekran. In order to get information about the formation of those concentrations, it would be necessary to keep scouts touring in these areas in April, May and June, and to arrange to deal with the incipient swarms promptly.

In this connection, of course, it should not be overlooked that British Mekran is only a part of a large area liable to produce swarms. There is little doubt that Southern Iran has similar outbreak centres, which are probably even more important as they are probably subject to immigration from the Arabian areas across the Straits of Ormuz. Unless international co-operation can be ensured, it would be rather difficult to "nip the worm in the bud".

In the above circumstances, I should venture to make the following few suggestions in regard to future work :—

1. *Ecological Work.*—A continuation of the present staff with a few additions. Considering the importance of the surveys in Mekran, it may be stated that there is only one Fieldman stationed at Turbat who has to cover an enormous area comprising Kech, Kolwah and Panjgur. There is moreover no information available in regard to the meteorological conditions of the interior if we except the station at Panjgur. If possible an Outpost of the nature of the Desert Outposts may be opened in a suitable place either in Kech or Kolwah. If not, it is necessary that the touring staff in Mekran must be augmented at least by one Fieldman and a messenger.

Dr. M. L. Roonwal suggests that, in view of the lack of information regarding the Iranian and Arabian coastal areas, some arrangements may be made for the visit of a touring party to these areas. I should think that this is a useful suggestion, and if possible some action may be taken in the matter during the ensuing year.

2. *Survey Work.*—The stations started in the Desert areas have proved their usefulness during the year, and I should suggest that the present system of survey work might be continued. In regard to the staff stationed at these Outposts, one Fieldman and one Messenger stay at the Outpost and attend to the meteorological observations and also attend to the local surveys within a distance of about 5 miles' radius, while the other Fieldman and his messenger tour in the areas roundabout within a radius of about 50—100 miles around the station. As the Fieldman stationed at the Outpost has to attend to the afternoon observations at 2 P.M., he has little time to do survey work properly as the only time he can have for this work is between 10 A.M. and 1 P.M. Consequently, some of the results shown to have been made on many days are really of little value, as they show results of surveys of only about a mile or so. It is suggested that he might be given help in the form of an observer on about Rs. 18 who should have enough of education to record the afternoon observations. The appointment of these men would be of great help in the work.

3. *Headquarters.*—The Biometrical Assistant has, as yet had no opportunity to do any work, on account of his transfer to Pasni. It is suggested that he might be retained for a full year, and that his pay might be raised to Rs. 125 inclusive of Karachi allowance. Owing to the increase of clerical work, another clerk has been included in the budget. On account of the increase of staff at headquarters, provision for an additional peon has also been made. As there is a good deal of compiling work to do, it is suggested that the present staff might be continued, inclusive of the Draftsman.

In the course of work at Panni and elsewhere it has been felt that an Artist would be of great help in painting the various stages of the locust and also the colour of the hind-wings in various forms, as it has been found to be of much significance in the recognition of the development of the locust. In case, it should be not possible to provide the services of one for Panni, it is requested that arrangements may be made with the Imperial Entomologist for the deputation of an Artist when needed.

In view of the possibility of the development of serious infestations in the future, it appears to be necessary to budget for a staff to be employed for experiments in control work, which will, of course, be employed only when a necessity should arise for the same.

It is also necessary to have plans prepared in regard to control work to be followed when an occasion should arise for it.

Y. RAMCHANDRA RAO,  
*Locust Research Entomologist,*  
*Karachi.*

*The 21st December 1935.*

## STATEMENT A-1.

## Khanpur—Bikaner Circle.

No.	Duration of Tour.	Personnel touring.	Districts.	Routes followed.
1	4th to 11th December, 1934.	Fieldman Dookinandan.	Bahawalpore.	Ahmadpur East, Dera-war, Khanpur.
2	2nd to 22nd December, 1934.	Fieldman, Bikaner Narain Behari.	East Jaisalmer.	Bikaner, Nokha, Barilpur, Bikan- pur, Nohla, Baru, Phalodi.
3	8th to 14th January, 1935.	Mr. Keshodas Baweja and Fieldman Dookinandan.	Bahawalpore.	Ahmadpur East, Dera-war, Khanpur.
4	18th January to 22nd February, 1935.	Mr. Keshodas Baweja and Fieldman Dookinandan upto Nokha and then Fieldman Narain Behari.	Bahawalpore, Jai- smer and Bikaner.	Khanpur, Sadiqa- bad, Kandera, Tanol, Ranso, Ram- garh, Mendha, Mohanagarh, Tarana, Nachac, Baru, Nokh, Girwar, Srikolayaji, Sardar bahar, Bhoja- war, Mahajan, Khanpur.
5	22nd January to 6th February.	Fieldman, Bikaner Narain Behari.	Bikaner, Jaisal- mer.	Dhaner, Badagan, Supetar, Parol, Johar, Barilpur, Ranjitpur, Bikan- pur, Nokh.
6	17th March to 19th April.	Mr. Keshodas Baweja and Field- man Mullharaj.	Bikaner, Jai sal- mer.	Sripurungar, Bai- shikhar, Sardar- shahr, Phalodi, Nokh, Kallagar, Bikanpur, Nachas, Chavara, Sirh, Phalodi.
7	20th March to 17th April.	Bikaner Fieldman Narain Behari.	Bikaner.	Sardarshahr, Baleri, Pani, Sahwa, Jait- pur, Mahajan, Kum- blan, Karnar, Sat- tanu, Dendrola, Radhar, Bikaner.
8	13th to 27th May	Mr. Keshodas Baweja and Khanpur Fieldman.	Bahawalpore and Dera Ghasi- Lhan.	Ahmadpur East, Dera-war, Dera GhasiLhan.
9	30th June to 20th July.	Mr. Keshodas Baweja.	Jaisalmer and Bikaner.	Phalodi, Nokh, Sar- darshahr.
10	11th to 27th July	Fieldman Narain Behari.	East Jaisalmer.	Nokh, Bikanpur, Channu, Nachun, Baru, Sirh, Phalodi.
11	21st to 27th July	Fieldman Mullharaj.	Bikaner.	Sardarshahr, Simla (Bikaner), Ranisar, Sompalser, Sardar- shahr.
12	1st to 6th August	Mr. Keshodas Baweja	Khairpur State.	Khairpur Mir's, Chang, Akra, Makna, Dhundh, Khanpur.
13	8th to 23rd August	Mr. Keshodas Baweja	Jaisalmer, Bikaner.	Nokh, Bikaner, Sar- darshahr, Karnali, Khanpur.

No.	Duration of Tour.	Personnel touring.	Districts.	Routes followed.
14	11th to 28th August.	Fieldman Behari. Narain	East Jaisalmer Western Bikaner.	Nokh, Girasar, Mankasar, Barsilpur, Jodasar, Pugal, Bandralla, Bikaner, Phalodi.
15	6th to 29th August	Fieldman Mulkhraj	Bikaner . .	Sardarshahr, Har-desar, Jaitpur, Bhojasar, Rojri, Pugal, Motigarh, Kallasar, Jamsar, Dungargarh and Ratangarh.
16	9th to 20th September.	Fieldman Behari. Narain	East Jaisalmer, Part of Bahawalpore West of Bikaner.	Nokh, Bara, Nachna, Bikampur, Ranjithpura. Barsilpur, Rukanpur, Khan-garh Fort, Barsilpur, Angren, Jaimalsar, Phalodi.
17	10th to 20th September.	Fieldman Mulkhraj	Bikaner . .	Sardarshahr, Ratangarh, Churu, Khin-wasar, Reni, Jabra-sar, Nohar, Rawat-sar, Rangmahal, Suratgarh, Sardarshahr.
18	3rd to 11th October.	Fieldman Deokinandan.	East Jaisalmer	Nokh, Bikampur, Girasar, Sidan, Phalodi.
19	12th to 31st October.	Fieldman Behari. Narain	East Jaisalmer.	Nokh, Nachna, Mohangarh, Lathi, Choyan, Sihar, Phalodi.
20	17th to 29th October.	Fieldman Shanti Sarup.	Bikaner . .	Sardarshahr, Har-desar, Jaitpur, Bhojasar, Rojri, Pugal, Motigarh, Jamsar, Sardarshahr.
21	6th to 16th November.	Fieldman Deokinandan.	East Jaisalmer.	Phalodi, Sidan, Girasar, Mankasar, Bikampur, Nokh.
22	17th to 30th November.	Fieldman Behari. Narain	East Jaisalmer.	Nokh, Nachna, Bakera, Choyan, Kanasar, Nokh.
23	5th to 20th November.	Fieldman Shanti Sarup.	Bikaner . .	Sardarshahr, Sujangarh, Sandwa, Jasrasar, Bikaner, Purnasar, Udrasar, Sardarshahr.

## STATEMENT A-II.

*Mirpurkhas—Barmer Circle:*

No.	Duration of Tour.	Personnel touring.	Districts.	Routes followed.
1	6th to 13th December, 1934.	Rohri Fieldman Abdul Latif.	Nawabshah District.	Nawabshah, Jam-sahib, Munro, Bandhi, Rohri.
2	20th to 30th December, 1934.	Do.	Sukkur District.	Mirpur Mathelo, Yaru Land, Dharan, Piarowaro Tar, Mamro, Rohri.
3	8th to 15th December, 1934.	Mr. Desraj Bhatia and Hyderabad Fieldman.	Thano Bula Khan Area.	Kotri, Thano Bula Khan, Jhimpir, Hyderabad.
4	3rd to 10th December, 1934.	Fieldman Peshaweri Singh.	Thar Area.	Gadra, Parna, Chachro, Ukloo, Chellar, Mitai, Naokot.
5	5th to 22nd January, 1935.	Mr. Desraj Bhatia and Fieldman Abdul Latif.	Khairpur area.	Thari, Akro, Khewari, Tujjal, Sorah, Gambat, Hyderabad.
6	7th January to 19th February.	Hyderabad Fieldman Amarnath.	Southern Thar Area Mallani.	Badin, Rahimki Bazaar, Suro, Diplo, Kurkasar, Islamkot, Jhangro, Virawal, Harrah, Bhakasar, Surachand, Chitalwana, Prussa, Dhorimana, Mithibori, Sarli, Barmer.
7	2nd to 27th January.	Chachro Fieldman.	Thar Area.	Umarkot, Kantio, Chachro, Chapur, Pabur-jo-Tar, Ahmad-jo-Tar, Khudi, Erwala, Islamkot, Chachro.
8	8th to 21st February.	Mr. Desraj Bhatia and Fieldman Girdhari.	Thar and South Marwar.	Jhuddo, Nawakot, Mithi, Chachro, Klisar, Gadra Road, Modran, Barmer, Hyderabad.
9	25th February to 5th March.	Mr. Desraj Bhatia and Fieldman Hyderabad.	Kachhi Area.	Bilput, Bhag, Shoran, Gandhawa, Nuttal, Hyderabad.
10	1st to 28th February.	Fieldman Abdul Latif.	Western Sind Area.	Schwan, Dubak, Shah Hasan, Tando Rahimkhan, Johi, Tharri, Mado, Mirzapur, Ghaibi Dero, Kambar, Akil, Rohri.
11	3rd to 23rd March.	Fieldman Girdhari Lal.	Thar Area.	Chachro, Islamkot, Kurkasar, Diplo, Drabro, Rahimki-Bazaar, Singhalo, Kharuk, Piloree, Mithi, Bhorilo.

No.	Duration of Tour.	Personnel touring.	Districts.	Routes followed.
12	11th to 20th March	Mr. Desraj Bhatia and Fieldman Abdul Latif.	Thar and Mallani	Chhor, Umarkot, Kantio, Chachro, Khisar, Gadra Road, Barmer.
13	24th March to 6th April.	Fieldman Peshaweri Singh.	Thar Area	Dharandero, Deori Sutanji, Gundi, Harrah, Pilujotar, Hayatjotar, Chachro.
14	13th to 17th April	Fieldman Abdul Latif.	Mallani	Sanawra, Sarli, Barmer.
15	4th to 15th May.	Mr. Desraj Bhatia and Chachro Fieldman.	Thar Area	Barmer, Gadra, Khisar, Chachro, Mahendero, Umarkot, Hyderabad.
16	17th to 31st May	Fieldman Girdhari Lal.	Thar Area	Chachro, Erniala, Pilu-jo-Tar, Misri-shah, Rawatsar, Kelnor, Chapur Khosa, Chachro.
17	23rd to 30th May	Fieldman Abdul Latif	Mallani	Barmer, Ramsar, Kelnor, Dedusar, Chohtan, Lachaki-Dhani, Barmer.
18	20th to 30th June	Fieldman Girdhari Lal.	Thar Area	Chachro, Bhadee, Navapura, Phangali, Dhakla.
19	6th to 22nd July	Mr. Desraj Bhatia and Fieldman Asaram.	Mallani	Barmer, Sanawra, Dhorimena, Rabasars, Charnor, Chachro, Khisar.
20	23rd July to 20th August.	Fieldman Girdhari Lal.	Thar Area	Gadra, Parna, Chachro, Chelar, Mithi, Kalohi, Rahimki, Bazsar, Drabro, Bhakro, Islamkot, Jhangro, Nagar Parkar, Pilu-jo-Tar, Hayat-jo-Tar, Chachro.
21	24th to 31st July	Rahmat Ali	South Marwar	Barmer, Luni, Samundri, Raniwara.
22	27th July to 14th August.	Mr. Desraj Bhatia and Fieldman Asaram.	West Sind and Kaachhi.	Dadu, Phulji, Hairokhan, Joli, Sitaroad, Kambar, Larkana, Bellput, Bhag, Gandhawa, Nuttall, Barmer.
23	19th to 29th August.	Mr. Desraj Bhatia and Fieldman Chachro Girdhari Lal.	Thar Area	Gadra, Khisar, Chachro, Chapur Khosa, Gadra Road, Jogi-ji-Vori, Parna, Chachro.
24	4th to 22nd August.	Rahmat Ali and a temporary Messenger.	Jasailmer Sheo Area.	Barmer, Bhadka, Sheo, Binjorai, Cholak, Phulia, Mayajiar, Gura, Lakha, Harsania, Tasingra, Barmer.



No.	Duration of Tour.	Personnel touring.	Districts.	Routes followed.
25	12th to 30th September.	Fieldman Girdhari Lal.	Thar Area .	Chachro, Mithatar, Charnor, Katahur, Chachro, Khisar, Gadra, Gadra Road, Parna, Kantio, Chachro.
26	20th August to 11th September.	Fieldman Asaram .	Mallani Area .	Barmer, Nilsar, Rabasar, Kitloria, Dhorimana, Gurha, Mithiberi, Sarli, Barmer.
27	17th to 24th September.	Mr. Desraj Bhatia and Locust Research Entomologist (in part).	Thar Area .	Mirpurkhas, Chhor, Umarnkot, Kantio, Chachro, Khisar, Gadra Road, Barmer.
28	3rd to 7th September.	Fieldman Peshaweri Singh.	Thar Area .	Chachro, Kantio, Umarnkot, Charkari, Chelar, Chachro.
29	5th to 26th September.	Fieldman Girdhari Lal.	Thar Area .	Chachro, Erniala, Mithi, Ploree, Kharuk, - Rahimki-Bazaar, Suro, Kurkasar, Islamkot, Virawah, Pulujo-Tar, Hayat-jo-Tar, Chachro.
30	2nd to 4th October.	Fieldman Moham-med Taj.	Mallani . .	Barmer, Jesai, Atimallani.
31	4th to 28th October.	Fieldman Asaram .	Khairpur South Jaisalmer Sheo Area. .	Mehrabpur, Thari, Sorah, Bewari, Ratno, Angsoi, Sanchoi, Wan-ki-Kheri, Santrahu, Mayajlar, Gara Lakha, Sheo, Barmer.
32	6th to 31st November.	Fieldman Peshaweri Singh.	Thar Area .	Chachro, Hayat-jo-Tar, Gundi, Harpalia, Alamsar, Pulujo-Tar, Parna, Chachro.
33	25th November to 1st December.	Fieldman Asaram .	Mallani Area .	Barmer, Chohtan, Rabasar, Nilsar, Barmer.

## STATEMENT A-III.

*Mekran Area.*

No.	Duration of Tour.	Personnel touring.	Districts.	Routes followed.
	<i>Gwadar Pishukan Area.</i>			
1	3rd to 6th December 1934.	Fieldman Abdul Hamid.	Pishukan	Gwadar, Pishukan, Jiwani, and back to Gwadar.
2	15th to 26th January 1935.	Do.	Pishukan Dasht Valley.	Pishukan, Jiwani, Gabd, Pathan, Bishuli, Kuntlar, Shuhzangi Kalat, Khabak, Ban, Kappar, Gwadar.
3	2nd to 7th February.	Do.	Pishukan Area.	Gwadar, Pishukan, Jiwani and back.
4	1st to 6th March	Fieldman Mohamed Sharif.	Do.	Gwadar, Pishukan, Jiwani, Akara.
5	5th to 11th April	Do.	Pishukan Santsar Area.	Gwadar, Pishukan, Jiwani, Gabd, Santsar, Gwadar.
6	8th to 15th May	Do.	Do.	Do.
7	6th to 13th June	Do.	Pishukan-Jiwani Santsar.	Do.
8	4th to 10th July	Do.	Gwadar-Pishukan Santsar.	Gwadar, Akara, Santsar, Jiwani, Pishukan, Gwadar.
9	1st to 7th August	Do.	Do.	Do.
10	9th to 16th September.	Do.	Pishukan-Santsar.	Gwadar, Pishukan, Jiwani, Gabd, Santsar, Chaghi, Akara, Gwadar.
11	9th to 15th October.	Do.	Do.	Gwadar, Akara, Garuk, Masnad, Santsar, Gabd, Jiwani, Pishukan, Akara.
12	8th to 13th November.	Do.	Do.	Santsar, Gabd, Jiwani, Pishukan, Akara, Gwadar.
	<i>Kech-Kolwah-Panjgur.</i>			
13	20th November to 16th December, 1934.	Fieldman Mohamed.	Kolwah Panjgur-Buloda.	Sami, Hoshap, Rodkari, Mithasing, Panjgur, Thana, Daragh, Shakrak, Buloda, Turbat.
14	12th to 31st January 1935.	Do.	Kech-Panjgur.	Turbat, Nasirabad, Tump, Mand, Aspikan, Wakai, Purohman, Siagisi, Sar-i-Parom, Dar-dumagh, Buloda, Turbat.

No.	Duration of Tour.	Personnel touring.	Districts.	Routes followed.
	<i>Kech—Kolwah—Panjgur—contd.</i>			
15	20th February to 15th March.	Fieldman Abdul Hamid.	Kolwah-Panjgur Kech.	Sami, Hoshap, Rodkan, Chambar Kalat, Goshanak, Awaran, Godri, Saleri, Mithsing Panjgur, Thana Daragh, Shakrak, Kirki, Buleda, Dardumagh, Sar-i-Parom, Siagisi, Purchinan, Wakai, Aspikan, Mand, Tump, Nasirabad, Turbat.
16	20th to 31st March.	Do.	Around Turbat	Turbat, Sami, Hoshap, Rodkan.
17	5th to 20th April	Do.	Kolwah-Panjgur	Chambar Kalat, Goshanak, Awaran, Godri, Saleri, Mithasing, Panjgur, Thana Daragh, Shakrak, Kirki, Buleda, Turbat.
18	24th and 25th April.	Do.	Around Turbat	Molid, Shahi Tump.
19	12th to 23rd May	Do.	Koch-Buleda	Turbat, Nasirabad, Tump, Mand, Aspikan, Wakai, Purchinan, Siagisi, Sar-i-Parom, Dardumagh, Buleda.
20	15th to 20th June	Do.	Nodez Ilaga	Turbat, Shashtal Rek, Nasirabad, Nokap, Golhdan, Turbat.
21	2nd to 11th July	Mr. Ramnath Batra and Fieldman Abdul Hamid.	Do.	Turbat, Shashtal Rek, Nokap, Nasirabad, Turbat.
22	1st to 26th August	Fieldman Abdul Hamid.	Panjgur Kolwah	Nodez, Panjgur, Ashdudh, Sehgazan, Gar, Surap, Tasp, Saleri, Godri, Awaran, Teer Tagi, Chambar Kalat, Rodkan, Hoshap, Sami, Turbat.
23	13th to 27th September.	Do.	Kech-Buleda	Turbat, Nasirabad, Shashtal, Nodez, Tump, Mand, Aspikan, Wakai, Purchinan, Siagisi, Parom, Dardumagh, Buleda, Turbat.
24	18th to 20th October.	Do.	Nodez Area	Turbat, Nasirabad, Shashtal, Nodez.
25	10th to 15th November.	Do.	Hoshap	Sami, Hoshap, Turbat.

No.	Duration of Tour.	Personnel touring.	Districts.	Routes followed.
	<i>Kech—Kolwah—Panjgur—concl'd.</i>			
25a	22nd to 30th November.	Fieldman Hamid. Abdul	Kolwah-Panjgur	Turbat, Sharak, Sami, Hoshab, Rodkan, Chambar-Kalat, Goshansk, Awaran, Godri, Saleri, Mithasing.
	<i>Kulanch—Dasht Area.</i>			
26	6th to 12th April	Fieldman Rahman. Abdul	Kulanch Area	Kandasole, Sawar Kaur, Kallag, Nokbur, Sardasht, Pasni.
27	8th to 14th May.	Do.	Do.	Kandasole, Chukin, Sawar Kaur, Kalag, Nokbur, Sardasht, Pasni.
28	1st to 20th June.	Fieldman Khushi Muhammad.	Kulanch-Dasht	Kandasole, Sawar Kaur, Kappar, Ban, Kuhak, Maksar Kaur, Bishuli, Zarenbug, Suntsar, Shahzangi-Kalat, Kuntidar, Kuhak, Ban, Nokbur, Sardasht, Pasni.
29	20th July to 8th August.	Do.	Do.	Kandasole, Sawar Kaur, Kappar, Ban, Kuhak, Bishuli, Zarenbug, Suntsar, Shazangi-kalat, Kuntidar, Kuhak, Ban, Nokbur, Sardasht, Ghulamanibent, Pasni.
30	6th to 26th September.	Do.	Do.	Do.
31	30th October to 7th November.	Fieldman Muhammad Sharif.	Do.	Pasni, Kandasole, Kappar, Ban, Kuhak, Bishuli, Zarenbug, Suntsar.
	<i>Ormara Area.</i>			
32	19th to 25th December 1934.	Mr. A. C. Sen	Ormara Area	Pasni, Ispihak, Gursunt, Basol, Kalimat, Kurmani, Ormara, Pasni.
33	19th March to 1st April 1935.	Fieldman Muhammad Aslam.	Do.	Rumra, Kalimat, Gazdan, Besole, Ormara.
34	17th to 29th April	Fieldman Rahman. Abdul	Do.	Rumra, Gazechah, Kalimat, Razak, Zat Rek, Kurmani, Ormara, Maniji Kaur, Had, Chad, Pasni.

No.	Duration of Tour.	Personnel touring.	Districts.	Routes followed.
	<i>Ormara Area</i> —contd.			
35	17th to 27th May	Fieldman Abdul Rahman.	Ormara Area .	Pasni, Rumra, Gazechah, Kalimat, Zat, Kurmani, Ormara, Maniji Kaur, Piri Kalat, Chad, Had.
36	2nd to 19th July	Do. .	Do. .	Pasni, Rumra, Gazechah, Kalimat, Razak, Zat, Kurmani, Ormara, Maniji Kaur, Piri Kalat, Chad, Ormara Hill, Basole, Makola, Buzi, Rumra, Pasni.
37	11th to 18th August.	Fieldman Muhammad Aslam.	Do. .	Pasni, Rumra, Gazechah, Gazdan, Kalimat, Zat, Basole Kurmani, Ormara; Had, Chad, Maniji Kaur, Pasni.
38	28th September to 14th October.	Fieldman Abdul Rahman.	Do. .	Pasni, Rumra, Gazechah, Kalimat, Zat, Kurmani, Maniji Kaur, Had, Chad, Piri Kalat, Ormara Hill, Basole, Makola, Buzi, Rumro, Pasni.
39	1st to 18th November.	Do. .	Do. .	Do.

## STATEMENT A-IV.

## Lasbela Area.

No.	Duration of Tour.	Personnel touring.	Districts.	Routes followed.
1	6th to 17th December 1934.	Fieldman Mohamed Shafi.	Reja Area	Liari, Torali River, Shoh Lakhra, Khaddi, Soresh, Thappi Thana, Wah Yara, Uthal, Sheikhranj, Ambagh.
	<i>Hingol Area.</i>			
2	10th to 21st February 1935.	Fieldman Naurata Singh.	Hingol	Ambagh, Pat, Bannodi, Churani K-nr. Nakhetri, Khandewari, Chandragup, Manjwari, Devri, Kund, Sapat, Pohr, Khandewari, Baddo, Ambagh.
3	17th to 20th March.	Do.	Do.	Sami Pir, Phat, Bannodi, Nakhetri, Khandewari, Chandragup, Manjwari, Devri, Hingol, Kund, Sangal, Sapat, Pohr, Chur, Nakhetri, Thappo.
4	20th April to 9th May.	Fieldman Mohamed Shafi.	Do.	Ambagh, Bannodi, Thappo, Gagu, Nakhetri, Khandewari, Chandragup, Sapat, Hingol, Kund, Devri, Sangal, Manjwari, Pohr, Khandewari, Kan Barar, Nakhetri, Liari, Baddo, Uthal, Kantro, Dirgo, Sheikhranj, Sami Pir, Ambagh.
5	13th to 28th June	Do.	Do.	Bannodi, Nakhetri, Sangal, Kund, Chandragup, Sapat, Pohr, Khandewari, Liari, Uthal, Sheikhranj, Ambagh.
6	14th to 31st August.	Do.	Do.	Bannodi, Nakhetri, Chandragup, Sapat, Kund, Hingol, Sangal, Drabi Kaur, Pohr, Rek, Khandewari, Liari, Uthal, Sheikhranj, Ambagh.

No.	Duration of Tour.	Personnel touring.	Districts.	Routes followed.
7	<i>Hingol Area</i> —contd. 26th October to 12th November.	Fieldman Mohamed Shafi.	Hingol . .	Bannodi, Nakhetri, Chandragup, Sapat, Sangal, . Kund, Khandewari, Pohr, Kan Bararh, Lari, Uthal, Sheikhraj, Ambagh.
8	<i>Hinidan Area.</i> 31st March to 9th April.	Do. .	Hinidan .	Got Sherkhan, Shah Bilawal, Hinidan, Thana Kila, Hasan Pir, Hab Chowki, Bhiwani, Naka Kharrari, Ambagh.
9	15th to 26th May	Fieldman Naurata Singh.	Do. .	Miran Pir, Windar, Got Sherkhan, Shah Bilawal, Hinidan, Kali Laki, Dinga, Kila, Hasan Pir, Gadani, Lak Baduk, Ambagh.
10	27th July to 5th August.	Fieldman Mohamed Shafi.	Do. .	Got Sherkhan Shah Bilawal, Hinidan, Kila, Hab Chowki, Ambagh.
11	20th to 30th Sep- tember.	Do. .	Do. .	Got Sherkhan, Shah Bilawal, Hinidan, Maidan, Thana Kila, Lang Lorani, Hab Chowki, Bhiwani, Naka Kharrari, Ambagh.

## STATEMENT B-I.

## Details of Locust Findings—Khanpur—Bikaner Circle

	Bahawalpur Area.	Locusts.		East Jaisalmer.	Locusts.		Bikaner Area.	Locusts.	
		Num-ber.	Popula- tion per sq. milo.		Num-ber.	Popula- tion per sq. milo.		Num-ber.	Popula- tion per sq. milo.
Winter. December to February.	1-11 XII-34 : A-I (1).			2-22 XII-31 : A-I (2).			24-31 I : A-I (5).		
	Dorawar area . .		Nil.	13-14 xii Nachna . .	3		Badrasar to Pugal . .		Nil.
	3-14 I : A-I (3).			18-20 xii Phalodi . .	2		11-20 II : A-I (4).		
	Dorawar area . .		Nil.	22-I to 10-II : A-I (3).			Srikolyat to Mahajan .		Nil.
	13-20 I : A-I (4).			Tanot to Baru . .	11	Nil.			
Spring. March to May	Sadiqabad-Kandera .		Nil.	8-ii Nokh . .	5	100			
				9-ii Girasar . .		50			
				1-6 II : A-I (5).					
				Barsilpur to Nokh .		Nil.			
	14-18 V : A-I (8).			28-III 9-IV : A-I (6).			17-25 III : A-I (6).		Nil.
	Derawar Area . .		Nil.	Phalodi, Nokh, Nachna, etc.			Sriganganagar, etc. .		
	21-24 V : A-I (8).						20-III to 17-IV : A-I (7).		
	Dera Ghazi Khan .	3 Hoppers.					28-20 III : Sahwa . .	2	



	Bahawalpur Area.	Locusts.		East Jaisalmer.	Locusts.		Bikaner Area.	Locusts.	
		Num-ber.	Popula-tion per sq. mile.		Num-ber.	Popula-tion per sq. mile.		Num-ber.	Popula-tion per sq. mile.
Summer. June to August	1-5 VIII : A-I (12). Chang, Akro, } Stray specimens found. M a k a n } Swarms visited this Dhundh. } area on the 10th and the 20th July.			11-27 VII : A-I (10). 15-vii Bikanpur . 16-vii Bikanpur . 17-vii Channu . 18-vii Channu . 19-vii Nachna . 20-vii Nachna . 21-vii Baru . 22-vii Baru . 23-vii Sihab . 24-vii Sihar . 29-vii Phalodi . 11-28 VIII : A-I (14). 11-viii Nachna-Girasar 12-viii Girasar . 13-viii Mankasar . 15-viii Barsilpur . 17-viii Jodasar . 18-viii Jodasar-Pugal over. 19-viii Pugal . 20-viii Bandrallo . 22-viii Bikaner .	11 9 9 8 124 126 10 42 3 3 5	55 72 72 50 1000 3000 500 500 50 25 50	21-27 VII : A-I (11). 23-vii Ranisar . 25-vii Sompalsar . 26-vii Sompalsar . 6-29 VIII : A-I (15). 7-viii Hardasar . 8-viii Hardasar-Jait- pur. 11-viii Jaitpur-Bhojra- sar. 12-viii Bhojrasar . 13-viii Bhojrasar-Rojri 16-viii Rojri . 19-viii Pugal . 24-viii Kainsar . 25-viii Jainsar . 29-viii Ratangar	4 9 12  13 2 19 13 52 20 30 10 3 1	280 630 1056  2308 470 2033 1850 4000 3020 4000 1000 250 50
Autumn. September to November.	Bahawalpur. 17-ix Rukanpur 18-ix Khangarh Fort			9-28 IX : A-I (16). 9-ix Baru . 11-ix Nachna . 14-ix Bikanpur 15-ix Barsilpur 16-ix Barsilpur .	2 2 3 3 1	528 264 396 396 132	70-29 IX : A-I (17). 10-ix Ratangarh . 18-ix Jainsar . 23-ix Rawatsar	1 1 3	30 H1 30 H3 100

22-ix Angren	2	264	17-29 X : A-I (20).	4	264
24-ix Jaimalsar i Hop- per.	7	924			
28-ix Phaledi	1	132	17-x Hardasab	2	132
3-II X : A-I (19).			20-x Jalpur	25	1060
3-x Bikampur	2	260	22-x Bhojrasar	3	396
5-x Bikampur-Girasar	14	2000	23-x Rojri	1	88
6-x Girasar	11	1500	26-x Motigarh	1	44
7-x Girasar to Sidan H 2.	34	5000	29-x Jamsar		
12-31 X : A-I (19).			5-20 XI : A-I (23).		
12-x to Nachna	14	1848	7-xi Sujangarh	1	14
16-x Nachna	8	2000	9-xi Sandwa	1	33
16-x Mohangarh	1	264	10-xi Jasrasar	1	88
18-x Mohangarh	2	264	15-xi Paurasar	7	924
19-x Mohangarh to Lathi.	4	1056	18-xi Udrasar	3	198
20-x Lathi	6	1500			
21-x Lathi	15	3960			
22-x Choyan	122	16104			
23-x Choyan	6	1584			
24-x Choyan to Sihar	2	528			
25-x Sihar	1	264			
6-15 XI : A-I (21).					
9-xi Girasar	3	792			
12-xi Markasar	2	528			
14-xi Bikampur	1	264			
17-30 XI : A-I (22).					
18-xi Nachna	1	240			
22-xi Choyan	3	720			
23-xi Choyan-Kanasar	10	300			
25-xi Kanasar	6	720			
26-xi Kanasar-Nokh	2	240			

STATEMENT B-II.

Details of Locust Findings—Barmer Circle.

	Kacchi-Sind.	Locusts.		Thar Parkar Area.	Locusts.		Malani-South Jaisalmer.	Locusts.	
		Num-ber.	Approximate population per sq. mile.		Num-ber.	Approximate population per sq. mile.		Num-ber.	Approximate population per sq. mile.
Winter. December to February.	6-13 XII-34 : A-II (1).			3-17 XII-34 : A-II (4).			1-3 XII-34.		
	Navabshah District .		Nil.	Gadra, Barma, Chellar to Mithi.		Nil.	Mayajhar-Lilma .		Nil.
	20-30 XII 34 : A-II (2).			7-30 I-35 : A-II (5).			31 I-19 II : A-II (6).		
	Sukkur Desert .		Nil.	Badin to Harrah .		Nil.	Bhakasar-Chitralwana-Barmer.		Nil.
	8-14 XII-34 : A-II (3).			2-27 I-35 : A-II (7).			16-20 II : A-II (8).		
	Thano Bulakhan area.		Nil.	6-1 Kantio to Chachro Other places .		1 Nil.	Jaswantpura-Barmer .		Nil.
	5-22 I-35 : A-II (5).			3-15 II : A-II (3).					
	Khairpur Area .		Nil.	Mithi, Chachro, Gadra .		Nil.			
	1-28 II : A-II (10).								
	West Sind area Sehwan, J o h i . Ghatibi Dero, Akul.		Nil.						

Spring. March to May	26 II to 4 III : A-II (9) Bhag-Shoran, Gandhar- wa.	Nil.	3-23 III : A-II (11). Islamkot, Diplo, Mithi, Chachro, etc. 24-III to 6-IV : A-II (13). East Thar area . 7-15 V : A-II (15). Gadru, Chachro, Mahen- dero, Umarkot. 16-31 V : A-II (16). 17-v Near Dhakla Other places in East Thar area.	Nil.	Nil.	1-17 IV : A-II (14). Barmer : Sanawra : Sarla. 23-30 V : A-II (17). Ramsar, Kolnor, Choh- tan, Barmer.	Nil. Nil.	
Summer. June to August.	12-VII to 12-VIII : A- II (22). West Sind Area : 28-vii Dadu . 29-vii Phulji . 30-vii Johi . 1-viii Hairokhan to Mado. 2-viii Mado . 6-viii Shadadkot . Kachhi area : 9-viii Bhag . 10-viii Gandhawa . 12-viii Nuttall	6 3 150 100 30 6 10 10 50	1800 250 46000 31000 9300 7000 3000 3000 7700	20-30 VI : A-II (18). 21-vi Bhadeo . 23-vi Navapura . 29-vi Dhakla . 14-21 VII : A-II (19). 15-vii Charnor 16-vii Charnor to Chachro. 21-vii Chachro-Khisar 22-vii Khisar-Gadra . 23-30 VII : A-II (20). 23-vii Gadra . 26-vii Parna . 26-vii Parna-Chachro 28-vii Chellar . 30-vii Mithi (Hoppers)	1 1 1 13 80 39 116	7-13 VII : A-II (19). 8-vii Sanawra . 10-vii Dhorimana . 11-vii Dhorimana to Rabasar. 12-vii Rabasar . 13-vii Rabasar . 14-vii Rabasar to Charnor. 21-VII to 1-VIII : A-II (21). 25-vii Balotra . 27-vii Samundri . 28-vii Jalor . 29-vii Raniwara	4 1 60 42 206 80 3 1 8 5	480 320 720 300 1200 1150

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STATEMENT No. B.-IV.

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1974-75 10/10/74 10/10/74

# History of Forest & Wildlife Department

Date	Particulars	Debit	Credit	Balance
	To Balance b/d			1000000
	By Govt. Grants		500000	1500000
	By Sale of Forest Produce		200000	1700000
	By Sale of Wildlife Products		100000	1800000
	By Other Income		50000	1850000
	To Salaries & Wages	800000		1050000
	To Fuel & Transport	200000		1250000
	To Maintenance	100000		1150000
	To Depreciation	50000		1100000
	To Other Expenditure	100000		1000000
	By Balance c/d			1000000
	Total	1850000	1850000	

	20-IV to 9-V: Tour A-IV (4).				13-V to 26-V: Tour A-IV (9).	Nil.
	23-iv Nakhetri .	5			100 to 200.	
	23-iv Chandragup- Sapat.	3			Locusts not noted anywhere.	
	27-iv Kund .	3				
	29-iv Sangal-Ma ij- vari.	6				
	30-iv Pohr .	1				
	1-v Khandewari- Pohr.	6				
	2-v Kan Barurh	2				
	3-v Nakhetri- Liari.	1				
	4-v Baddo .	5				
	Other places	Nil.				
SUMMER. June to August.	13-28 VI: Tour A- IV (5).				27-VII to 5 VIII: Tour A-IV (10).	
	15-vi Nakhetri .	1		50 to 300.	28-vii Golshekhan .	69
	17-vi Sangal .	2			29-vii Shah Būwa .	83
	19-vi Kund .	3			31-vii Binidan .	92
	21-vi Chandragup- Sapat.	1			2-viii Kila .	13
	22-vi Pohr Coastal area.	11			(Locusts found mostly pink or yellow, presumably immigrants of the July incursion).	1800* to 3000.
	23-vi Khandewari	1				
	28-vi Shaikhrnj .	3				



Season.	Bela Area.	Locusts.		Hingol Area..	Locusts.		Minidan Area.	Locusts.	
		No.	Ap- proxi- mate popula- tion per square mile.		No.	Ap- proxi- mate popula- tion. per square mile.		No.	Ap- proxi- mate popula- tion per square mile.
AUTUMN. September to November.				14-17 VIII : Tour A- IV (6). 15-viii Bannodi . 17-viii Nakhetri . 19-viii Chandragup- Sapat. 21-viii Kund-Hingol 23-viii Sangat . 25-viii Pohr Reks . 26-viii Khandowari 28-viii Liari . 30-viii Uthal . 31-viii Shaikhranj .	9 2 90 23 12 101 24 3 8 61	600 to 3,500  Popula- tion mostly immu- grants.		20-30 IX : Tour A-IV (11). 23-ix Shah Bilawal . 24-ix Minidan .	7 1 About 200.
				26-X to 12 XI : Tour A-IV (7). 29-x Nakhetri . 31-x Chandragup- Sapat. 2-xi Kund. 4-xi Sangal . 6-xi Pohr . 7-xi Kan Barath 9-xi Liari . 12-xi Shaikhranj . (Locust population con- sisting mostly of specimens with more or less hyaline wings).	12 22 51 27 27 27 1 1				

# STATEMENT C.1—PASNI-REEKS.

## (Results of Intensive Surveys).

NOTE.—The condition of the ovaries given below on one or two dissections only in each fortnight and should therefore be accepted with caution.

Months.	Number of Surveys.	Total number of Locusts observed during each Fortnight.	Male.	Female.	Approximate population per square mile during each survey	Condition of ovaries.	Rainfall.	Remarks.
December 1934— 1st . . .	4	..	Nil.	Nil.	0	Not examined.	0.06"	No locusts were observable since September 1934. The first specimen, a male, was found on the 15th December. (The first shower of rain was received on the 14th December, and amounted to 0.06").
2nd . . .	4	12	0	0	10—40	Immature .	1.02"	
January— 1st . . . 2nd . . .	5 8	12 16	5 8	7 8	0—34 0—40	Partially mature Fully mature .	2.48" 2.96"	Cold Spell.
February— 1st . . . 2nd . . .	3 6	11 24	7 11	4 13	0—40 16—98	Mature . Mature .	4.36" Nil.	Nil. Nil.
March— 1st . . . 2nd . . .	7 7	23 12	12 5	11 7	0—06 0—50	Almost mature. Almost mature.	Nil. Nil.	No hoppers found. Hoppers of all stages noticed.

Months.	Number of Surveys.	Total number of Locusts observed during each Fortnight.	Males.	Females.	Approximate population per square mile during each survey.	Condition of ovaries.	Rainfall.	Remarks.
April— 1st . . .	3	11	3	8	4—180	Mature . .	Nil.	First new generation adults found on the 8th, and numerous hoppers found.
2nd . . .	10	347	214	133	100—464	Mature . .	Nil.	
May— 1st : : .	7	438	244	194	156—435	Immature : .	Nil.	27 hoppers. 80 hoppers.
2nd : : .	6	142	72	70	45—170	Immature : .	Nil.	
June— 1st : : .	5	90	51	48	55—140	Mature . .	Nil.	142 hoppers in special areas. 84 hoppers in special areas. One pair found copulating in one of the "Special areas". 23 hoppers of all stages found. Population on 8th was 134 per square mile. On the 12th it suddenly increased to 2,245 per square mile.
2nd : : .	6	72	42	30	26—132	As before	Nil.	
July— 1st . . .	3	180	83	97	80—6,204	Mature . .	Nil.	Numerous hoppers of all stages found. Population increasing rapidly.
2nd . . .	6	6,881	Lo custa.	..	2,200—13,000	Mature . .	Nil.	
August— 1st . . .	5	5,148	Lo custa.	..	3,700—48,000	Partially mature	Nil.	Hoppers mainly of I and II stages found in special areas.
2nd . . .	9	3,818	Lo custa.	..	1,800—11,500	Partially mature	Nil.	

September— 1st . . .	9	3259 Locusts.	..	1,200—3,400	Mature . .	Nil.	388 hoppers in special areas.
2nd . . .	3	177 Locusts.	..	680—1,008	Mature . .	Nil.	38 hoppers in special areas.
October— 1st . . .	6	354 Locusts.	..	40—1,229	Mature . .	Nil.	81 hoppers in special areas.
2nd . . .	8	321 Locusts.	..	40—608	Mature . .	Nil.	35 hoppers in special areas.
November— 1st . . .	7	284 Locusts.	..	264—768	Mature . .	Nil.	No hoppers.
2nd . . .	6	110 Locusts.	..	160—518	Immature . .	Nil.	One IV stage hopper found on 19th at Ganda-Koh. Migrant locusts with more or less hyaline wings noticed.

STATEMENT C-2.  
Results of Intensive Surveys—Guadar Reks.

Months.	Fort- night.	Number of Surveys during Fort- night.	Number of Locusts found during Fortnight.		Approximate locust population rate per square mile during surveys.	Condition of Ovaries.	Rainfall.	Remarks.
			Male .	Female.				
December 1934 .	1st .	4	Nil.	1	30	..	Nil.	Locusts were not found in November 1934.
	2nd .	3	4	1	80—150	..	5·25"	
January 1935 .	1st .	5	20	12	} 200—400 {	..	1·92"	
	2nd .	Nil.	∴	..		..	2·80"	
February 1935 .	1st .	1	Nil.	1	} 50—100 {	..	0·67"	
	2nd .	6	4	2		..	Nil.	
March 1935 .	1st .	5	2	1	} 25—60 {	Nearly mature	Nil. {	57 Hoppers during the month. I Emergence in First week of March.
	2nd .	7	1	Nil.		..		
April 1935 .	1st .	8	12	14	} 25—250 {	..	0·01"	19 Hoppers. Adults all of the new generation.
	2nd .	3	8	6		..	Nil.	
May 1935 .	1st .	4	9	5	} 30—150 {	Mature .	Nil.	
	2nd .	6	26	7		..		
June 1935 .	1st .	6	16	11	} 30—200 {	Partially mature	Nil.	
	2nd .	6	13	7		..		

July 1935	1st	4	50	31	250—700	..	Nil.	Sudden increase of population from the 12th July. Specimens mainly pinkish, only a few yellow.
	2nd	6	235	190	300—2,500	..		
August 1935	1st	6	1380	} 3,000—7,000		Some partially mature.	Nil.	
	2nd	3	1090	}				
September 1935	1st	4	755	} 1,500—6,000		Immature	Nil.	
	2nd	8	976	}				
October 1935	1st	3	317	1,500—3,000		..	Nil.	
	2nd	5	183	250—500				
November 1935	1st	1	40	About 1,600		..	Nil.	
	2nd	8	231	400—1,500				

STATEMENT C-3.  
Results of Intensive Surveys—Ambagh Station.

Month.	Fort- night.	Number of Surveys.	Total number of Locusts observed during the Fortnight.		Approximate rate of locust population per sq. mile during Surveys.	Condition of Ovaries.	Rain- fall.	Remarks.
			Male.	Female.				
December 1934 .	1st	5	1	4	15-24	..	Nil.	
	2nd	6	4	1	20-48	..	0.50"	
January 1935 .	1st	5	Nil.	Nil.	..	..	..	
	2nd	6	Nil.	Nil.	..	..	0.92"	Cold wave from 12th to 17th January.
February .	1st	6	..	1	About 15	..	0.78"	
	2nd	8	Nil.	Nil.	..	..	..	
March .	1st	6	Nil.	Nil.	..	..	Nil	
	2nd	8	Nil.	Nil.	..	..	Nil	
April .	1st	6	1	..	About 16	..	0.86"	
	2nd	6	..	1	About 24	..	0.52"	
May .	1st	6	1	..	About 10	..	Nil.	
	2nd	6	1	..	About 24	..	Nil.	
June .	1st	6	2	6	10-32	..	Nil.	Ratios mostly solitary. Most of the locust specimens collected had bluish stripes and were evidently recently fledged ones.
	2nd	7	28	21	32-544	..	Nil.	
July .	(1-8-vii)	3	7	8	48-216	Mostly bluish	0.38"	Population increased suddenly owing to an incursion from out side. Ratios mostly gregarious or intermediate.
	1st (12-15-vii).	3	Over 200 Loc. observed each day	Over 200 Loc. observed each day	3,500-30,000			

	2nd	11	2,370	Loc. .	700-27,000	Almost mature	Nil.	
August	1st 2nd	6 6	719 335	Loc. . Loc. .	400-12,000 600-1,000	Almost mature Almost mature	Nil. 0-07"	Population found decreasing gradually.
September	1st 2nd	6 6	249 232	Loc. . Loc. .	800-1,300 250-1,000	Almost mature Almost mature	0-05" Nil.	
October	1st 2nd	5 8	74 152	Loc. . Loc. .	180-840 140-1,400	Almost mature Immature ovaries.	Nil. 0-06"	On 5th October 1 V-stage hopper was found at Naka Kharrari. Slight increase in population noticeable.
November 1935	1st 2nd	5 7	143 270	Loc. . Loc.	300-1,500 210-1,000	Immature ovaries. Immature ovaries.	Nil. Nil.	Mostly forms of a recently fledged generation met with. Ratios mostly solitary.



## STATEMENT C-4.

*Results of Intensive Surveys—Chachro Outpost.*

Month.	Fort- night.	No. of surveys during Fort- night.	Total number of locusts observed during Fortnight	Approximate rate of Locust population per sq. mile during the surveys.	Condition of Ovaries.	Rain- fall.	Remarks.
December 1934	1st 2nd	7 7	Nil. Nil.	.. ..	.. ..	Nil. Nil.	
January 1935	1st 2nd	6 11	Nil. Nil.	.. ..	.. ..	Nil. 0.41"	
February	1st 2nd	8 8	Nil. Nil.	.. ..	.. ..	Slight. Nil.	
March	1st 2nd	8 9	Nil. Nil.	.. ..	.. ..	Nil.	
April	1st 2nd	8 11	Nil. Nil.	.. ..	.. ..	0.27" 0.04"	
May	1st 2nd	10 10	Nil. 3 locusts	.. ..	.. ..	Nil. Nil.	2 locusts on 22nd May and 1 locust on 27th May.
June	1st 2nd	12 12	Nil. 8 locusts	.. ..	.. ..	Nil. Nil.	
July	1st 2nd	12 9	44 loc. upto 11th 623 loc. from 12th to 15th. over 192 locusts	80—8,000 3,000 —30,000 1,000—40,000	Immature About mature ..	7.21 0.97"	Increase of population was caused by an influx of locusts from the West commencing on the 12th July. Hoppers found on 28th July 1935.

August	1st	2nd	8	135 loc.	6	83 loc.	2,500—30,000 300—8,000	Many mature Many mature	Nil 2-47"	Numerous Hoppers. First adult of new generation seen on 31st August 1935.
September	1st	2nd	12	147 loc.	10	198 loc.	1,000—14,000 1,000—7,500	A few mature ..	0.49" Nil.	Hoppers present.
October	1st	2nd	8	168 loc.	10	323 loc.	700—9,600 3,000—15,000	.. ..	Nil. 0-50"	A few hoppers. Increase possibly due to arrival of migrants from East.
November	1st	2nd	9	77 loc.	8	54 loc.	80—7,200 50—3,800	.. ..	Nil. Nil.	A few hoppers.

## STATEMENT C-5.

*Results of Intensive Surveys—Barmer Outpost.*

Month.	Fort- night.	No. of surveys during Fort- night.	Total number of locusts observed during Fortnight.	Approximate rate of Locust population per sq. mile during surveys.	Condition of Ovaries.	Total Rain- fall.	Remarks.
December 1934 .	1st . 2nd.		Not visited.				
January 1935 .	1st . 2nd.		Not visited.				
February .	1st . 2nd .	3	Not visited. No locusts were met with during the visit of 17-20-II.				
March .	1st . 2nd .	5	Not visited. No locusts were seen during visit of 20th to 31st March.				
April .	1st . 2nd .	7 10	Nil. Nil.	.. ..	.. ..	.. ..	Barmer outpost was started on 1st April 1935.
May .	1st . 2nd .	8 7	Nil. Nil.	.. ..	.. ..	Nil. Nil.	
June .	1st . 2nd .	9 12	4 locusts 8 locusts	About 100 pcr. sq. mile. About 100—200	.. ..	Nil. Nil.	
July .	1st . 2nd .	12 13	13 loc. (I-10-VII) 203 Loc. (11-11-VII). 140 Loc. .	80—700 1,000—8,000 800—4,800	Immature Almost mature Many mature	2-69" 0-13"	A sudden incursion of locusts appears to have occurred on the 11th July.

August	1st 2nd	13 13	111 loc. 53 loc.	2,000—13,000 Nil to 6,000	.. ..	0·10" 1-50"	Hoppers found in good numbers, population has decreased.
September	1st 2nd	10 15	24 loc. 155 loc.	Nil to 3,000 400—7,500	Some found with mature ovaries. ..	1·60" Nil.	Leucists of new generation mostly. Hoppers in small numbers.
October	1st 2nd	8 14	79 loc. 105 loc.	600—2,800 Nil to 9,600	.. ..	Nil. Nil.	Hoppers found in small numbers.
November	1st 2nd	12 8	15 loc. 3 loc.	25—180 30—90	.. ..	Nil. Nil.	No hoppers. Population has de- creased greatly.

## STATEMENT C-6.

*Results of Intensive Surveys—Nokh Outpost.*

Month.	Fort-night.	No. of Surveys during fort-night.	Total No. of Locusts observed during fortnight.	Approximate rate of population per sq. mile during the surveys.	Condition of ovaries.	Rain-fall.	Remarks.
December 1934 .							
January 1935 .							
February 1935 .	1st .	2	4M + 7F .	..	..	..	Result of 2 surveys made by Mr. K. D. Baweja during his visit to Nokh on tour.
March 1935 .							
April 1935 .	1st .	1	Nil	..	..	..	No locusts were found on the 31st March and 1st April by Mr. Keshodas during his 2nd tour.
May 1935 .	1st . 2nd .	10 10	Nil 1 F. on 29th .	.. 1 per sq. mile .	.. ..	.. ..	Station was opened on 1st May.
June 1935 .	1st . 2nd .	8 7	38 locusts 34 locusts	5-8 4-12	Mature . ..	A little Nil	
July 1935 .	1st . 2nd .	3 9	3 locusts Over 200	2-10 60-2,000	.. ..	2.90" 4.0"	

August 1935	1st	10	10 Locusts Over 100	500—3,000 500—3,000 (about 28,000 per sq. mile on 27th August.)	Mature	W2 1-1 1/2"	New Generation adults began to appear on 31st.
	2nd	8					
September 1935	1st	9	59	250—3,000	..	9-43"	Hoppers were found.
	2nd	9	59	250—3,000	..	0-15"	
October 1935	1st	10	64	1,000—3,200	..	Nil	*Possibly migrants from East none found after 21st.
	2nd	9	92	500—8,500	..	0-0 1/2"	
November 1935	1st	8	34	100—720	..	..	..
	2nd	8	14, no locust after 21st.	1,818*	..	..	

## STATEMENT C-7.

*Results of Intensive Surveys—Sardarshahr Outpost.*

Month.	Fort- nights.	No. of Surveys during fort- night.	Total No. of Locusts observed during fortnight.	Approximate ratio of population per- sq. mile during the surveys.	Condition of ovaries.	Rain- fall.	Remarks.
December 1934	1st : 2nd :	8 8	<i>Nil</i> <i>Nil</i>	. ..	.. ..	.. 0.52"	
January 1935	1st : 2nd :	9 11	<i>Nil</i> <i>Nil</i>	.. ..	.. ..	1.36"	
February 1935	1st : 2nd :	8 9	<i>Nil</i> <i>Nil</i>	.. ..	.. ..	0.55" ..	.
March 1935	1st : 2nd :	9 11	<i>Nil</i> <i>Nil</i>	.. ..	.. ..	0.56"	
April 1935	1st : 2nd :	9 10	<i>Nil</i> ..... <i>Nil</i>	.. ..	.. ..	0.55" 0.02"	..
May 1935	1st : 2nd :	9 10	<i>Nil</i> <i>Nil</i>	.. ..	.. ..	.. ..	..
June 1935	1st : 2nd :	9 10	<i>Nil</i> { 1 male on 26th 1 F. on 28th.	.. 2-4	.. ..	0.29" 9.80"	..
July 1935	1st : 2nd :	13 6	40 13	12-1,500 50-200	Ovaries mature ..	2.53" 3.99"	-
August 1935	1st : 2nd : ..	9 8 ..	1 locust 1 hopper 5 locusts hop- pers.	440 200-150	.. ..	0.03" 0.42"	1 hopper IV found. Numerous hoppers found.

September 1935	1st 2nd	8 11	5 27	60—220 80—224	.. ..	2.33" 1.06"	New generation locusts began to appear, a few hoppers.
October 1935	1st 2nd	9 11	9 3	20—132 20—40	.. ..	.. 0.10"	No locusts noted after 22nd.
November 1935	1st 2nd	11 12	<i>Nil</i> <i>Nil</i>	.. ..	.. ..	.. ..	Locusts not observable.



## STATEMENT D.

*Movements of the Locust Research Entomologist During 1935.*

1. January 1935	12—23 I	. Visit to Delhi for the Locust Committee meeting.
2.	26—29 I	. Visited Ambagh with the Assistant Locust Research Entomologist.
3. February 1935	7—15 II	. Tour in Thar-Parkar District, with Mr. D. R. Bhatia visiting Mithi, Chachro Outpost and Gadra.
	16—22 II	. Tour in the Sardarshahr Area with Mr. Keshodas Baweja visiting Sardarshahr, Bhojasar and Mahajan.
4. March 1935	3—11 III	. Visit to Pasni Field Station.
5. April 1935	24—26 IV	. Visit to Pasni along with the Vice-Chairman of the Imperial Council of Agricultural Research by aeroplane.
6. May 1935	3—5 V	. Visit to Barmer for the selection of the site for the Barmer Outpost.
7.	18th	. Visit to Ambagh Station.
8. May-June 1935	26 V to 3 VI	. Visit to Pasni.
9. June-July 1935	23 VI to 30 VII	. Visit to Pasni.
10. August 1935	9—15 VIII	. Visit to Nokh Outpost with Mr. K. D. Baweja.
11. August-September.	18 VIII to 8 IX	. Visit to Pasni.
12. September 1935	18—25 IX	. Visit to the Chachro area, Chachro Outpost and Barmer Outpost with Mr. D. R. Bhatia.
13. October 1935	2nd October	. Visit to Ambagh Station.
14.	13—20 X	. Visit to Pasni.
15. November 1935	7th November	. Visit to Ambagh Station with Dr. Roonwal.
16.	24th XI to 3rd December.	. Visit to Pasni Station in connection with the Annual Report.

STATEMENT E-1.

Rainfall Data for 1935.

Month.	Panigur.	Mund.	Turbat.	Gwadar.	Pasni.	Ormara.	Bela.	Ambagh.	Karachi.	Chachro.	Barmer.	Nokh.	Sardar-shahr.
December 1934	2.68	0.90	1.59	3.25	1.66	1.82	0.72	0.50	0.21	Nil	Nil	0.10	0.52
January 1935	1.10	3.04	2.72	4.81	6.74	3.05	0.79	0.92	0.74	0.41	0.92	Nil	1.36
February 1935	2.18	5.19	3.95	0.90	2.93	6.09	2.46	0.78	1.63	Nil	Nil	Nil	0.55
March 1935.	Nil	Nil	0.29	Nil	Nil	Nil	Nil	Nil	0.7	Nil	Nil	Nil	0.56
April 1935	2.06	2.14	2.14	0.01	0.11	1.77	2.41	1.38	1.47	Nil	0.32	Nil	0.57
May 1935	0.08	0.44	Nil	Nil	Nil	Nil	0.20	Nil	Nil	Nil	0.03	Nil	Nil
June 1935	Nil	Nil	Nil	Nil	Nil	Nil	0.29	Nil	Nil	Nil	Nil	Nil	1.09
July 1935	Nil	Nil	Nil	Nil	Nil	Nil	0.48	0.38	0.39	8.18	3.67	6.22	6.52
August 1935	Nil	Nil	Nil	Nil	Nil	Nil	0.05	0.07	0.26	2.47	1.90	Nil	1.05
September 1935	Nil	Nil	Nil	Nil	Nil	Nil	0.18	0.05	Nil	0.49	1.60	0.58	3.39
October 1935	Nil	Nil	Nil	Nil	Nil	Nil	0.03	0.06	drizzle Nil	0.50	Nil	0.04	0.10
November 1935	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Total	8.40	11.71	10.59	10.97	11.44	13.63	7.61	4.14	5.43	12.06	10.44	6.94	15.71

## STATEMENT E-2.

*Rainfall data for 1934.*

Month.	Panigur.	Mand.	Turbat.	Gwadar.	Pasni.	Ormara.	Bela.	Ambagh.	Karachi.	Chachro.	Barmer.	Nokh.	Sardar-shahr.
December 1933	Nil	0.04	0.30	..	0.03	..	..	..	..	..	..	..	..
January 1934	0.22	0.16	0.20	..	0.63	0.34	0.18	0.08	..	..	..	..	..
February 1934	..	..	..	..	..	..	..	..	..	..	..	..	..
March 1934.	0.22	0.23	..	0.1	..	..	0.80	0.04	0.31	0.02	..	..	0.60
April 1934	0.25	0.18	..	..	..	..	..	..	..	..	..	..	..
May 1934	..	..	..	..	..	..	..	..	..	..	..	..	..
June 1934	0.51	0.87	1.08	..	0.43	0.24	1.61	2.16	1.53	2.10	0.70	1.30	1.27
July 1934	..	..	0.34	..	..	..	1.28	1.10	5.71	4.58	1.91	3.52	0.90
August 1934	1.18	0.10	0.21	..	0.02	..	2.60	0.97	0.28	0.28	5.83	8.45	6.58
September 1934	..	..	..	..	..	..	0.31	..	..	0.01	..	..	0.34
October 1934	..	..	..	..	..	..	..	..	..	..	..	..	..
November 1934	0.20	..	..	..	..	..	..	..	..	..	..	..	..
Total from December 1933 to November 1934.	2.58	1.58	2.13	0.1	1.11	0.38	9.78	4.35	7.83	6.99	8.44	13.27*	9.69

\* Total for 11 months.

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STATEMENT No F(1) PASNI.

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## STATEMENT

*Monthly data in regard to various Meteorological Observations taken on the Pasni*

Months.	Screen.			Open Air Temperature °C	Sand	
	Min. & Max. humidity.	Humidity at at 0 A.M. & 5 P.M.	Temperature °C		Surface. °C	2" °C
December 1934 . . .	68%±15	70% & 64%	20°1±4°0	18°3±6°0	24°0±0°7	22°4±1°8
January 1935 . . .	57%±10	64% & 51%	15°0±6°7	16°8±11°4	18°1±8°1	17°5±5°1
February . . .	72%±10	81% & 57%	19°6±4°9	21°6±10°7	24°1±10°0	21°7±5°3
March . . .	64%±17	63% & 56%	22°5±6°0	25°2±13°4	33°8±18°4	26°0±6°0
April . . .	71%±10	67% & 60%	21°7±5°7	28°1±11°7	35°0±7°8	31°2±7°4
May . . .	73%±14	60% & 65%	27°4±6°1	30°2±12°1	38°0±17°7	34°2±7°9
June . . .	82%±14	73% & 77%	29°4±4°9	34°1±11°7	40°5±16	37°0±7°7
July . . .	86°5%±8°5	81% & 61%	29°0±8°2	32°9±9°1	41°0±14°2	37°4±6°4
August . . .	79%±11	78% & 74%	26°8±3°1	31°2±9°7	38°6±14°0	35°1±6°3
September . . .	82%±16	83% & 74%	26°3±4°4	29°4±10°3	38°2±16°1	34°2±7°2
October . . .	73%±14	73% & 73%	25°6±6°8	28°9±14°4	33°6±16°6	30°2±7°5
November . . .	63%±18	63% & 60%	23°0±7°3	25°8±12°6	30°3±13°6	27°0 6°5
Monthly average for the whole year.	72°6%±14	72°8% & 66%	24°2±5°4	29°75±11°2	33°0±13°6	29°6 6°5

No. F(1)—PASNI.

*rek during a period of 12 months from December 1934 to November 1935.*

Temperature. °	Sand Moisture.		Evaporation.		Wind.		Rainfall.	Variation of Barometric pressure.
	2"	4"	Sun.	Shado.	Total Miles-ago.	Max. Velocity per hour.		
22°1±2°1	8°11%	3°0%	7°1	3°0	135	13	1°68"	30°05 to 30°35
17°0±3°4	7°3%	6°0%	10°4	5°1	185	15°5	5°44"	29°95 to 30°35
21°1±4°0	8°28%	8°61%	6°7	3°8	166°0	15°6	4°85"	29°95 to 30°25
26°2±4°5	2°08%	4°06%	11°5	8°5	151	15°9	<i>Nil</i>	29°91 to 30°15
20°7±4°1	1°5%	1°8%	11°2	8°2	203°6	19	0°12"	29°81 to 30°09
30°8±2°7	1°07%	1°15%	11°6	8°9	238	24	<i>Nil</i>	29°7 to 29°97
35°0±4°1	0°9%	1°0%	9°9	7°04	244	22°5	<i>Nil</i>	29°6 to 29°85
36°1±3°5	1°0%	1°12%	8°4	0°4	196	20	<i>Nil</i>	29°61 to 29°77
34°0±3°4	0°74%	0°70%	7°5	4°8	182°5	18	<i>Nil</i>	29°65 to 29°96
32°7±3°7	0°92%	0°81%	8°4	3°5	204	22	<i>Nil</i>	29°7 to 30°08
29°0±4°0	0°66%	0°66%	11°7	7°0	141	16	<i>Nil</i>	29°95 to 30°27
26°7±3°7	0°53%	0°54%	10°2	6°2	90	17	<i>Nil</i>	30°15 to 30°40
28°5±3°6	2°34%	2°46%	9°55 cc.	0°1 cc.	178	24 Max.	11°60" Total Rainfall.	29°84 to 30°12

## STATEMENT

*Monthly Data in regard to various Meteorological Observations taken at November*

Month	Temperature				Humidity		Soil			
	Av. Daily F	Range	Screen.		Open air.		Surface		2° Deep.	
			Av. Daily O	Range	Av. Daily	Range	Av. Daily O	Range	Av. Daily	Range.
December 1934.	68.2	±18.2	20.5	±6.0	66.5	±18.5	22.8	±10.1	22.4	±5.6
January 1935	60.0	±14.3	16.1	±7.0	59	±16	19.7	±13.3	16.6	±5.6
February .	67.4	±12.0	20.0	±6.0	71.5	±14.5	24.4	±11.3	22.1	±7.1
March .	78.0	±11.1	23.8	±0.0	59	±7	30.15	±17.3	29.9	±5.7
April .	79.1	±9.0	27.2	±6.4	64.75	±8.25	33.1	±12.8	30.1	±7.5
May .	78.35	±4.55	26.55	±6.75	65.9	±3.4	36.2	±13.70	34.5	±7.2
June .	80.6	±7.7	31.0	±5.3	72.05	±8.45	38.8	±12.8	35.8	±7.0
July .	85.3	±6.0	30.05	±3.85	77.75	±12.25	37.0	±10.4	37.4	±6.6
August .	81.05	±5.05	29.35	±4.05	75.8	±12.1	36.4	±11.4	36	±6.9
September .	81.05	±6.35	28.7	±4.0	74.05	±14.15	36.3	±12.7	35.85	±7.05
October .	78.05	±14.05	27.3	±0.7	59.75	±21.05	32.3	±15.7	30.05	±8.05
November .	73.9	±14.4	24.2	±8.7	63	±21	29.1	±15.2	28.2	±7.0
Average for the year.	76.0	0.0	25.8	0.7	65.1	12.8	31.4	12.1	30	7

± Symbol denotes

No. F(2)

*Ambag during a period of 12 months from December 1934 to 1935.*

temperature.				Evaporation		Wind.		Variation of Barometer	Rainfall
4" Deep		6" Deep		Av. Daily Shade	Sun	Total mileage in 24 hours	Max. Velocity per hour	Pressure	
Av. Daily °C	Range	Av. Daily °C	Range						
21° 0	± 3° 0	21° 7	± 2° 2	c.c. 3° 55	7° 5	23° 96	4° 03	30° 0—30° 40	0° 5
17° 0	± 4	17° 4	± 2° 0	4° 0	11° 2	56° 25	8° 27	29° 0—30° 40	0° 02"
21° 2	± 5° 2	21° 4	± 3° 5	2° 65	6° 05	47° 6	6° 50	29° 78—30° 00	0° 78"
25° 6	± 5° 3	25° 9	± 3° 3	0° 0	10° 70	50° 4	8° 05	29° 71—30° 02	Nil
20° 1	± 5° 3	20° 6	± 3° 5	8° 37	11° 07	92° 12	9° 61	29° 67—30° 3	1° 38"
33° 4	± 4° 4	33° 4	± 2° 2	9° 72	11° 01	104° 02	11° 01	29° 81—30° 15	Nil
36° 0	± 5° 1	35° 7	± 2	7° 02	10° 07	...	...	29° 61—29° 08	Nil
35° 75	± 4° 35	35° 25	± 2	7° 05	9° 80	...	...	29° 0—29° 87	0° 38"
34° 4	± 5° 0	33° 5	± 2	6° 77	9° 02	...	...	29° 7—30° 0	0° 07"
33° 7	± 4° 3	33° 4	± 2° 5	5° 2	7° 37	80° 40	9° 18	29° 83—30° 1	0° 05"
29° 4	± 4° 2	29° 5	± 2° 2	10° 34	12° 38	57° 20	8° 13	30° 03—30° 09	0° 06"
25° 8	± 4° 0	29° 2	± 1° 4	0° 7	7° 07	...	5° 7	30° 16—30° 40	Nil
28° 7	4° 6	28° 6	2° 5	0° 6	0° 7	...	...	...	4° 14" Total Rainfall.

(plus or minus).



## STATEMENT No. F(3)

Monthly Data in regard to various Meteorological Observations taken at the Observation Post Sardar Shahr during a period of 12 months from December 1934 to November 1935

Month	Temperature			Humidity		Soil temperature						Evaporation				
	Av. Daily F	Range	Abs. Max F	Abs. Min F	Av. Daily	Range	Surface.		2' Deep.		4' Deep.		6' Deep.		Av. Daily in Shade	Rain- fall
							Av. Daily O	Range	Av. Daily O	Range	Av. Daily O	Range				
December 1934	61.1	±14.4	87	37	54.25	±13.75	20.3	±12.8	18.7	± 7.0	18.5	± 4.3	19.4	± 3.1	c.c.	0.32"
January 1935	53.2	±14.2	78	24.5	54.6	±17.6	17.1	±12.9	13.9	± 0.2	14.25	± 4.35	15	± 2.8	6.72	1.30"
February	62.75	±13.25	86	43	56.4	±21.7	22.55	±12.45	19.05	± 0.65	19.25	± 4.45	19.55	± 3.05	9.12	0.55"
March	72.47	±10.52	99.5	46.5	40.3	± 20	20.89	±16.41	25.5	± 7.8	25.0	± 5.2	25.23	± 3.75	17.0	0.50"
April	77.72	±14.37	105	56.5	48.82	±17.82	31.4	±10.6	39.25	± 8.25	28.2	± 5.4	28.5	± 3.4	10.8	0.37"
May	91.87	±10.24	115.5	64	23.44	±11.5	42.25	±18.04	38.5	±10.06	35.97	± 5.58	35.64	± 6.02	29.5	NZ
June	96.49	±13.29	116	73.5	33.34	±13.92	42.49	±14.71	30.2	± 8.25	37.67	± 4.87	37.7	± 2.92	30.67	1.09"
July	89.7	± 9.6	112.5	72.0	62.5	±10.8	38.3	±10.5	35.25	± 5.85	31.45	± 3.85	34.85	± 2.75	13.8	0.52"
August	87.1	± 9.9	104	72	63.5	±16.5	39.35	±13.05	35.85	± 7.25	34.75	± 4.45	35.3	± 3.4	14.9	1.05"
September	84.5	±10.9	104.5	65.5	63	± 21	36.5	±11.3	33.65	± 6.75	32.5	± 4.5	33.1	± 3.3	12.4	3.30"
October	77.25	±16.85	99.0	51.7	38.5	±20.5	32.5	±16.7	30.2	± 8.0	28.85	± 5.55	29.15	± 3.15	16.2	0.10"
November	68.2	±18.4	94.2	41.0	43.5	±22.5	28.0	±16.2	21.2	± 9	23.6	± 6	23.9	± 3.0	12.7	NZ
Average for 12 months.	76.9	±13.2	100.1	54.1	49.2	±17.7	31.6	±14.6	29.4	± 7.7	27.7	± 4.9	28.1	± 3.3	16.0	15.71" Total Rain-fall

$\pm$  Symbol denotes plus or minus.

## STATEMENT NO. F(4)

Monthly Data in regard to various Meteorological Observations taken at the Observation post Chachro during a period of 12 months from December 1934 to November 1935

Month	Temperature				Humidity.		Soil temperature.						Evaporimeter			
	Av. Daily mean F	Range	Abs. Max mean F	Abs. Min mean F	Av. Daily	Range	Surface		2" Deep		4" Deep		6" Deep.		Av. Daily Shade.	Rain-fall.
							Av. Daily C	Range	Av. Daily C	Range	Av. Daily C	Range	Av. Daily O	Range		
December 1934	67.95	±16.55	93	37.8	38.5	±11.5	26.95	±14.85	23.0	±8.2	22.6	±3.7	22.85	±1.93	8.6 8.7	...
January 1935	57.8	±15.8	82.8	23	41.85	±17.85	22.05	±16.15	19.1	±7.9	19.3	±4.0	19.7	±2.6	7.8	0.41"
February	68.4	±13.6	90.7	15.0	46.1	±22.7	25.53	±17.43	24.5	±8.3	24.9	±4.9	24.0	±2.6	9.7	NH
March	70.66	±18.05	101.7	49	30.5	±17.5	33.05	±21.95	32.0	±10.9	30.8	±5.2	20.1	±1.8	12.4	NH
April	82.45	±15.15	106	31.8	42.5	±24.5	37.75	±19.75	34.1	±8.9	33.0	±5.6	33.1	±2.2	12.2	0.31"
May	91.9	±16.1	114.7	70.1	48.0	±27	44.3	±21.1	41.6	±10.0	30.65	±5.35	39.9	±2.1	22.1	NH
June	93.6	±13.6	113	75.5	53.5	±27.3	44.1	±17.9	41.55	±8.95	40.75	±5.25	45.3	±7.7	20.9	NH
July	87.85	±8.15	105	74.0	67.5	±16.5	38.2	±11.5	35.8	±6	35.35	±4.15	33.75	±2.85	11.3	9.18"
August	83.0	±7.8	99.5	72.0	70	±17	36.35	±11.95	33.85	±5.53	33.7	±4.0	33.85	±3.15	10.7	2.47"
September	83.7	±11.5	101.0	63.5	66	±26	38.6	±16	34.9	±6.8	34.7	±5.4	35.3	±4.5	9.9	0.49"
October	80.1	±10.6	100.7	50.0	41.5	±23.5	36.7	±19.7	32.05	±7.85	31.6	±5.1	32.25	±1.65	10.0	0.50"
November	74.6	±17.4	98.0	40.8	42.8	±24.2	31.7	±18.0	27.1	±7.5	26.8	±5.5	27.4	±4.3	9.0	NH
Average	79	±14.4	100.3	53.7	49.3	±21.3	35.0	±17.2	31.7	±8.1	31.1	±5	31.6	±3.1	12.1	12.36" Total Rain-fall.

±Symbol denotes plus or minus.

## STATEMENT NO. F(5)

Monthly Data in regard to various Meteorological Observations taken at the Observation Post Barmer during a period of six months from June to November 1935

Month	Temperature			Humidity		Surface		Soil Temperature				Evaporo meter	
				Av. Daily	Range	Av. Daily	Range	2' Deep		1' Deep		6" Deep	
	Av. Daily F	Range	Abs. Max. F					Av. Daily C	Range	Av. Daily C	Range	Av. Daily C	Range
January 1936	...	...	...	...	...	...	...	...	...	...	...	...	...
February	...	...	...	...	...	...	...	...	...	...	...	...	...
March	...	...	...	...	...	...	...	...	...	...	...	...	...
April	...	...	...	...	...	...	...	...	...	...	...	...	...
May	...	...	...	...	...	...	...	...	...	...	...	...	...
June	63.3	±13.3	114.6	77	±37.5	49.65	±16.95	40.87	±7.87	41.15	±4.55	40.05	±2.35
July	89.0	±7.3	101.7	70.1	±15.5	37.75	±10.75	35.0	±1.7	34.65	±3.25	31.15	±2.15
August	83.1	±8.4	106.1	71.0	±15	36.45	±11.75	33.1	±5	33.2	±3.5	32.55	±2.5
September	82.95	±10.65	103.1	67	±20.5	36.8	±12.0	31.4	±0.8	33.5	±4.6	33	±3
October	82.15	±11.15	100.0	60.1	±14.5	36.85	±16.95	33.3	±7.7	32.0	±4.7	31.9	±2.2
November	76.2	±11.0	95.0	51.5	±15	31.9	±10.7	29.0	±8.5	28.1	±1.7	27.5	±2.4

± Symbol denotes plus or minus.

## STATEMENT NO. F(6)

*Monthly Data in regard to various Meteorological Observations taken at the Observation Post Nokh during a period of seven months from May to November 1935*

Month	Temperature				Humidity		Surface		Soil temperature				Evaporemeter			
	Range		Abs. Max. F	Abs. Min. F	Av. Daily	Range	Av. Daily O	Range	2" Deep		4" Deep		6" Deep		Av. Daily in Shade	Rainfall
	Av. Daily F	Range	Av. Daily F	Range					Av. Daily O	Range	Av. Daily O	Range				
					Av. Daily F	Range	Av. Daily O	Range					Av. Daily O	Range	Av. Daily O	Range
January 1935	...	...	...	...	...	...	...	...	...	...	...	...	...	...	c c.	...
February	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
March	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
April	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
May	92.5	±14.5	117	64	22.9	±8.8	42.5	±18.8	38	±7.3	36.35	±2.85	35.6	±.8	...	...
June	96.99	±13.16	116	76	33.29	±16.00	40.8	±18.4	40.1	±3.9	39.75	±2.25	39.45	±1.35	...	...
July	90.55	±9.05	110	70.3	38.5	±10.5	39.35	±10.95	37.3	±1.3	36.85	±2.65	36.65	±2.15	...	...
August	85.95	±7.25	106.8	75.3	35.5	±10.6	41.05	±15.05	37.45	±5.85	36.6	±3.9	36.45	±2.95	9.35	6.9"
September	86.4	±11.8	105.3	68.8	35.55	±22.25	39.0	±14.2	36.0	±6	35.1	±1.2	35.05	±3.15	12.3	1.14"
October	78.9	±18.0	101.9	52.2	36.0	±18.4	34.35	±16.95	31.4	±7.1	30.55	±3.75	30.75	±1.86	15.9	0.58"
November	71.2	±19.7	96.3	45.4	38	±20	28.5	±17.1	25.9	±7.8	25.5	±3.9	25.8	±1.6	16.6	0.01"

± Symbol denotes plus or minus.

## STATEMENT G-1.

*Experiments on the influence of the quality of food on Sex-Maturity of Schistocerca.*1935 Summer Season—*Panama*.

Particulars of Food.	Cage No.	Date of Emergence.	Date of first appearance of yellow in wings.	Time taken in days.	Date of first Oviposition.	Length of period of sex-maturation (days).	No. of Ovipositions.	Duration of life of Female.	General Remarks.
Fresh Murrand	B <sub>3</sub>	22-25-V	Not noted	..	27-VI	33-36	..	..	3 pairs were kept in one cage so that the egg-masses laid by each cannot be discriminated.
Do.	B <sub>11</sub>	29-V	15-VI	16	3-VII	35	..	..	Do.
Do.	C <sub>1</sub>	30-VI	19-VII	19	10-VIII	40	..	..	Experiment discontinued after first egg-laying.
Do.	C <sub>6</sub>	8-VII	28-VII	18	14-VIII	37	3	66	Died on 12-IX-35.
Do.	C <sub>9</sub>	30-VII	14-VIII	15	29-VIII	30	4	67	Died on 5-X-35.
Do.	C <sub>17</sub>	9-VIII	29-VIII	20	12-IX	31	1	38	Died on 16-IX-35.
Average	..	..	..	17-6	..	35	..	..	
Old Murrand	B <sub>18</sub>	22-25-V	Not noted	..	8-VII	44-47	..	..	Probably one eggmass only.
Do.	B <sub>14</sub>	28-30-V	Not noted	..	8-VII	40-42	..	..	Do.
Do.	C <sub>2</sub>	1-VII	22-VII	21	6-VIII	36	..	..	Female kept on fresh murrand for a week before setting up the experiment; discontinued after one egg-laying.

Do.	C <sub>7</sub>	10-VII 31-VII	6-VIII 26-VIII	27 26	29-VIII No oviposition	50	3	76 72	Died on 24-IX-35. Killed by a centipede on 11-X-35. Ovaries not dissected out.
Do.	C <sub>10</sub>	9-VIII	5-IX	27	No oviposition		..	70	Died on 18-X-35; Ovaries half mature.
Average	..	..	..	25-26	..	.. 13-1	..	..	
Old Murrand wet- ed.	O <sub>3</sub>	2-VII	26-VII	24	30-VIII	59	1	59	Died on 30-VIII-35.
Do.	C <sub>8</sub>	7-VII	30-VII	23	30-VIII	54	2	85	Died on 30-IX-35.
Do.	C <sub>11</sub>	1-VIII 23-VIII	12-IX 9-IX	42 18	..	..	..	..	Found missing: 16-IX-35.
Do.	C <sub>22</sub>				13-X	52	1	52	Died on 13-X-35.
Average	..	..	..	20-75	..	55	..	..	
Old Murrand with moist atmos- phere.	B <sub>11</sub>	31-V	24-VI	24	15-VII	45	..	..	3 pairs in one cage, so that egg-laying of each could not be discriminated.
Do.	B <sub>11</sub>	31-V	24-VI	24	17-VII	47	..	..	Do.
Do.	C <sub>12</sub>	2-VIII	22-VIII	20	..	..	..	..	Female flew away on 29- VIII-35.
Do.	C <sub>12(1)</sub>	19-VIII	18-IX	26	..	..	..	37	Female flew away on 24- IX-35.
Do.	C <sub>14</sub>	14-VIII	9-IX	26	28-IX	45	3	58	Killed by centipede: 21- X-35.
Do.	C <sub>31</sub>	22-VIII	9-IX	18	4-X	43	1	..	Do.
Average	..	..	..	23	..	45	..	..	

1935 Autumn Season—*Pasna*.

Particulars of Food.	Cage No.	Date of Emergence.	Date of first appearance of yellow in wings.	Time taken in days.	Date of first Oviposition.	Length of period of sex maturation (days).	No. of Ovipositions.	Duration of life of Female.	General Remarks.
Fresh Murrand	C <sub>36</sub>	1-IX	18-IX	14	1-X	27	5	64	Died on 7-XI-35.
Do.	C <sub>37</sub>	3-IX	24-IX	19	12-X	37	3	37	Died on 21-XI-35.
Do.	C <sub>38</sub>	17-IX	3-X	16	13-X	28	6	..	Being continued.
Do.	C <sub>39</sub>	14-X	29-X	15	..	..	..	..	No egg-laying upto 29-XI-35.
Do.	C <sub>32</sub>	1-X	20-X	19	..	..	..	..	Do.
Do.	C <sub>44</sub>	16-X	15-XI	30	..	..	..	..	Do.
Average	..	..	..	18.8	..	30.6	..	..	
Old Murrand	C <sub>39</sub>	18-IX	12-X	24	..	..	..	..	No egg-laying upto 20-XI-35.
Do.	C <sub>53</sub>	9-X	2-XI	24	..	..	..	..	Do.
Average	..	..	..	24	..	..	..	..	
Old Murrand wetted Do.	C <sub>111</sub> C <sub>110</sub>	18-IX 19-IX	3-X 31-X	17 43	28-XI 23-XI	40 65	3 ..	57 ..	Died on 14-XI-35. Being continued.
Average	..	..	..	30	..	52.5	..	..	

Old Murrand with moist atmos- phere. Do. Do.	C <sub>12A</sub> C <sub>13</sub> C <sub>30</sub>	25-IX 12-IX 25-IX	12-X 3-X 20-X	17 21 25	.. 4-XI ..	.. 53 ..	.. 2 ..	.. .. ..	No egg-laying upto 20-XI-35. Being continued. Has not laid eggs so far: 20-XI-35.
Average	..	..	..	21	..	..	..	..	..



STATEMENT G-2.

*Experiments on the influence of the quality of food on Sex-Maturity of Schistocerca.*

1935 Summer Season—Pasni.

Particulars of Food.	Cage No.	Date of Emergence.	Date of first appearance of yellow in wings.	Time taken in days.	Date of first Oviposition.	Length of period of sex-maturation (days).	No. of Ovipositions.	Duration of life of Female.	General Remarks.
Jowari .	C <sub>23</sub>	10-VIII	27-VIII	18	1-IX	25	6	58	Died on 7-X-35. It had partially mature eggs at time of death; laid eggs every 5th day.
	C <sub>21</sub>	13-VIII	20-VIII	16	3-IX	21	2	36	Died on 18-IX-35.
	C <sub>25</sub>	18-VIII	1-IX	10	2-IX	20	3	37	Died on 19-IX-36.
	C <sub>26</sub>	20-VIII	5-IX	14	12-IX	23	3	43	Died on 2-X-35.
Average .	..	..	..	10.7	..	22.25	..	..	
Kulliek .	C <sub>5</sub>	4-VII	10-VII	12	10-VIII	37	..	..	Experiment discontinued after the 1 egg-laying.
	C <sub>15</sub>	6-VIII	3-IX	28	22-IX	47	2	65	Died on 10-X-35.
	C <sub>14</sub>	6-VIII	20-VIII	23	6-IX	31	2	62	Died on 7-X-35.

Killed by centipede on  
28-IX-35.

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	C <sub>30</sub>	9-VIII	1-IX	23	10-IX	38	2	..	
Average	..		..	21.6	..	38.5	..	..	
Balibur	C <sub>20</sub>	25-VII	17-VIII	23	6-IX	43	1	73	Died on 6-X-35.
	C <sub>21</sub>	27-VIII	22-IX	26	16-X	50	1	78	Died on 13-XI-35.
	C <sub>22</sub>	10-VIII	3-IX	22	..	..	..	..	Killed by centipede on 30-IX-35.
	C <sub>23</sub>	25-VIII	22-IX	28	16-X	52	1	89	Died on 22-XI-35.
Average	..	..	..	24.75	..	49	..	..	
Karzan	C <sub>17</sub>	3-VI	Not noted	..	20-VIII	76	2	91	Died on 4-IX-35; had half-developed eggs.
	C <sub>18</sub>	6-VIII	22-VIII	16	..	..	..	54	Died on 29-IX-35; had immature ovaries.
	C <sub>19</sub>	7-VIII	25-29-VIII	22	19-IX	43	1	60	Died on 6-X-35.
	C <sub>22</sub>	22-VIII	24-IX	33	..	..	..	65	Died on 22-XI-35.
Average	..	..	..	23.60	..	..	..	59.5	

1935 Autumn Season—*Pasni*.

Particulars of Food.	Cage No.	Date of Emergence.	Date of first appearance of yellow in wings.	Time taken in days.	Date of first Oviposition.	Length of period of sox-maturation.	No. of Ovipositions.	Duration of life of Female.	General Remarks
Jowar	C <sub>31</sub>	4-IX	16-IX	12	30-IX	26	1	54	Died on 28-X-35.
	C <sub>32</sub>	4-IX	18-IX	14	2-X	28	1	58	Died on 1-XI-35.
	C <sub>13</sub>	18-IX	3-X	15	14-XI	57	3	..	Being continued.
	C <sub>15</sub>	19-IX	3-X	11	17-X	28	3	56	Died on 14-XI-35; had fully mature eggs.
	C <sub>17</sub>	23-IX	9-X	16	..	..	..	..	No egg-laying upto 29-XI-35.
	C <sub>31</sub>	29-IX	9-X	10	21-XI	53	2	..	Being continued.
	C <sub>36</sub>	9-X	24-X	15	..	..	..	..	No egg-laying upto 29-XI-35.
Average	..	..	..	13.7	..	38.4	..	..	
Kullchik	C <sub>12</sub>	17-IX	22-IX	68	..	..	..	..	No egg-laying upto 29-XI-35.
	C <sub>17</sub>	10-X	..	..	..	..	..	..	No change upto 29-XI-35.
Average	..	..	..	68	..	..	..	..	

Balibur	C <sub>46</sub>	19-IX	9-X	51	..	..	..	..	No egg-laying upto 29-XI-35.
	C <sub>53</sub>	3-X	24-XI	52	..	..	..	..	Do.
Average	..	..	..	51.5	..	..	..	..	
Karzan	C <sub>45</sub>	19-IX	3-XI	44	..	..	..	..	No egg-laying upto 29-XI-35.
	C <sub>45</sub>	10-X	3-XI	26	..	..	..	..	Do.
Average	..	..	..	35	..	..	..	..	

## STATEMENT H.

*Incubation period in relation to sub-soil temperature—with notes on Sex-Ratio and colour of Hatchings.*

Ref. No	Oviposition	Emergence	Incubation period (days)	Average temp. at 4" depth.	No. of hoppers and colour.	Sex ratio.	
						Male	Female
H <sub>1</sub>	18-2-35	19-3-35	29	22° 0' ± 3° 0	60 green.		
H <sub>2</sub>	1-3-35	31-3-35	29½	23° 5' ± 2° 4	66 green		
H <sub>3</sub>	3-3-35	2-4-35	29½	23° 3' ± 2° 7	73 green.		
H <sub>11</sub>	15-3-35	9-4-35	25	21° 2' ± 2° 2	10 mixed.		
H <sub>12</sub>	13-3-35	9-4-35	27	24° 1' ± 2° 2	19 mixed.		
H <sub>13</sub>	19-3-35	15-4-35	27	24° 1' ± 2° 2	115 green		
H <sub>14</sub>	30-3-35	21-4-35	25	23° 3' ± 2° 3	125 green.		
H <sub>15</sub>	31-3-35	24-4-35	24	25° 3' ± 2° 3	105 green		
H <sub>16</sub>	30-6-35	15-6-35	16	30° 85' ± 6° 05	62 mixed.		
H <sub>22</sub>	30-6-35	13-7-35	13	33° 5' ± 5° 6	39 green except 1.	20	10
H <sub>21</sub>	3-7-35	10-7-35	13	30° 6' ± 2° 8	36 black except 1	21	15
H <sub>24</sub>	5-7-35	20-7-35	15	32° 2' ± 1° 2	13 green and 1 black	28	19
H <sub>27</sub>	13-7-35	27-7-35	14	31° 0' ± 3° 4	51 black	30	21
H <sub>28</sub>	11-7-35	29-7-35	15	30° 76' ± 3° 35	28 black and 8 green	21	16
H <sub>29</sub>	13-7-35	29-7-35	16	30° 0' ± 3° 4	56 green	35	21
H <sub>30</sub>	15-7-35	31-7-35	16	30° 5' ± 3° 1	36 mixed	24	12
H <sub>32</sub>	6-8-35	23-8-35	17	29° 5' ± 3° 7	52 black	37	15
H <sub>33</sub>	10-8-35	27-8-35	17	29° 45' ± 3° 05	22 black	9	15
H <sub>34</sub>	10-8-35	27-8-35	17	29° 45' ± 3° 05	55 green except 2	28	27
H <sub>37</sub>	20-8-35	8-9-35	19	29° 2' ± 4° 7	35 green except 1	19	16
H <sub>38</sub>	29-8-35	16-9-35	17	29° 1' ± 5° 1	70 green	42	37
H <sub>39</sub>	29-8-35	16-9-35	18	29° 15' ± 5° 05	47 mixed	31	16
H <sub>41</sub>	30-8-35	18-9-35	19	19° 1' ± 5° 0	42 mixed	20	22
H <sub>42</sub>	2-9-35	19-9-35	17	28° 9' ± 4° 8	51 mixed 3 eaten by hoppers.	24	24
H <sub>44</sub>	4-9-35	23-9-35	19	28° 5' ± 1° 5	56 green	30	26
H <sub>47</sub>	6-9-35	25-9-35	19	28° 2' ± 4° 7	62 green	31	28
H <sub>48</sub>	6-9-35	25-9-35	19	28° 2' ± 4° 7	(3 escaped). 43 mostly black.	28	16
H <sub>49</sub>	9-9-35	28-9-35	19	27° 6' ± 4° 6	24 mixed	8	16
H <sub>51</sub>	12-9-35	2-10-35	20	27° 3' ± 4° 5	33 black.		
H <sub>51(a)</sub>	12-9-35	2-10-35	20	27° 3' ± 4° 5	21 green.		
H <sub>52</sub>	14-9-35	4-10-35	20	27° 1' ± 4° 5	49 mixed	23	26
H <sub>53</sub>	16-9-35	6-10-35	20	26° 7' ± 4° 5	22 mixed	9	13
H <sub>54</sub>	18-9-35	9-10-35	21	26° 6' ± 4° 4	8 black remained, rest eaten by centipede.	5	8
H <sub>55</sub>	17-9-35	10-10-35	23	26° 7' ± 4° 5	13 mixed	5	8
H <sub>56</sub>	22-9-35	20-10-35	28	26° 3' ± 7° 0	28 mixed.		

STATEMENT H—*contd.*

Ref. No.	Oviposition.	Emergence.	Incubation period (days).	Average temp. at 4" depth.	No. of hoppers and colour.	Sex ratio.
						Male : Female.
H <sub>47</sub>	1-10-35	24-10-35	23	26° 3 ± 7° 0	40 Mostly green .	27 : 10
H <sub>48</sub>	4-10-35	26-10-35	22	26° 25 ± 8° 25	12 green . . .	8 : 4
H <sub>49</sub>	2-10-35	27-10-35	25	26° 3 ± 7° 7	38 green.	
H <sub>51</sub>	6-10-35	31-10-35	25	26° 06 ± 7° 05	11 green . . .	9 : 5
H <sub>52</sub>	9-10-35	1-11-35	23	26° 55 ± 7° 35	20 green . . .	17 : 12
H <sub>53</sub>	10-10-35	8-11-35	23	27° 0 ± 5° 7	16 mixed (1 hopper escaped).	11 : 4
H <sub>54</sub>	15-10-35	8-11-35	21	27° 0 ± 6° 0	11 green . . .	10 : 1
H <sub>55</sub>	15-10-35	8-11-35	24	27° 0 ± 0° 0	37 green . . .	18 : 19
H <sub>57</sub>	16-10-35	10-11-35	25	26° 0 ± 6° 5	25 green . . .	13 : 12
H <sub>58</sub>	28-10-35	11-11-35	14	26° 3 ± 2° 0	15 black . . .	7 : 8
H <sub>59</sub>	22-10-35	17-11-35	26	26° 3 ± 3° 0	15 green . . .	7 : 8
H <sub>60</sub>	23-10-35	17-11-35	25	26° 4 ± 3° 3	26 green except 1 .	17 : 9
H <sub>61</sub>	23-10-35	18-11-35	26	26° 25 ± 3° 45	53 green . . .	27 : 26

## STATEMENT I.

*Post-Embryonic development in relation to atmospheric temperature and humidity.*

Ref. No.	Date of hatching.	Date, of acquiring wings.	Total post-embryonic period in days.	Average temp. (screen)	Average humidity (screen).	No. of hoppers.	Sex ratio of adults	
							Male	Female.
B.	14-3-35	20-4-35 to 9-5-35	43 to 56	24.6—6.0	68%—18%	24	18	adults.
H <sub>10</sub>	8-4-35	14-5-35 to 17-5-35	36 to 39	25.0—6.0	60%—10%	10	8	: 3
H <sub>11</sub>	21-6-35	1-8-35 to 14-8-35	38 to 51	28.6—3.2	81%—9%	...	3	: 8
H <sub>12</sub>	2-7-35	8-8-35 to 17-8-35	37 to 40	28.0—2.8	835%—8.5%	33	3	: 8
H <sub>13</sub>	20-9-35	1-11-35 to 30-11-35	42 to 71	24.0—6.8	70%—16%	30	1	: 2
H <sub>14</sub>	23-9-35	1-11-35 to 27-11-35	39 to 65	25.0—7.0	70%—16%	50	4	: 3
H <sub>15</sub>	20-9-35	2-11-35 to 23-11-35	37 to 58	25.05—7.05	69%—16%	34		: 2

## STATEMENT J.

*Notes on the daily rhythm of the desert locust. (Dr. M. L. Roonwal).*

Some observations had been made and recorded in 1933, 1934 and 1935 in regard to a study of the daily programme of locusts at Pasni and an attempt is made here to arrange the available data and to make some general deductions. It is apparent that temperature is the main factor that governs the degree of activity of locusts, and consequently the nature and degree of activity at particular parts of the day vary according to the season and for this purpose it has been found useful to divide the year into 3 seasons :—

A. Hot Season. (April—October. Average temperature =  $26-32^{\circ}\text{C}$ ).

B. Cold Season. (December and January. Average temperature =  $15-21^{\circ}\text{C}$ ).

C. Mild Season. (February, March and November. Average temperature =  $19-24^{\circ}\text{C}$ ).

The "mild season" is a period of transition, subject to a rapid change of temperature. February is somewhat cold, while March and November are rather warm.

The time of the day has been, for the sake of convenience divided from the point of view of the rhythm, into (1) morning (6—9 A.M.), (2) fore-noon (9—11 A.M.), (3) mid-day and after-noon (11 A.M.—5 P.M.), (4) evening (5—9 P.M.) and (5) night (9 P.M.—6 A.M.).

These observations were made on non-gregarious adult locusts in field cages (several in a cage), and on green and black hoppers both in the field and in Warden cages (several in a cage).

The following is a classified summary of the available observations on the Daily rhythm of the Locust at Pasni. (A.T.—Air temperature in sun. S.T.—Temperature of soil surface).

#### *A. Hot Season.*

##### *1. Adults.*

NOTE.—Observations made in August 1933 in large cage  $3' \times 3' \times 3'$  and in May 1935 in field cages.

##### *Morning—*

6 A.M. Rather sluggish ; do not jump or fly on approach (A. T.  $24^{\circ}\text{C}$ ).

7 A.M. Beginning to be active (A. T.  $24.4^{\circ}\text{C}$ ).

8 A.M. Active and feeding ; jump and fly on approach. (A. T.  $26.6^{\circ}\text{C}$ ).

9 A.M. Active and feeding ; jump and fly on approach. (A. T.  $26.6^{\circ}\text{C}$ ).

##### *Forenoon—*

10 A.M. } No observations.  
11 A.M. }



## Mid-day and afternoon—

12 NOON	}	Active and feeding. Fly away on approach (A. T. 32°C).
1 P.M.		
2 P.M.		
3 P.M.		
4 P.M.		
5 P.M.		

## Evening—

6 P.M.	}	Fairly active on approach.
7 P.M.		
8 P.M.		
9 P.M.		

Night.—No observations.

2. *I Stage Hoppers (Black).*

NOTE.—Observations made in August 1933, in large cage 3' × 3' × 3'.

## Morning—

- 6 A.M. Inactive; sitting on bush or on the side of cage (A. T. 24°C).
- 7 A.M. Beginning to be active. Jump on approach.
- 8 A.M. Sitting on top of bush and basking (A. T. 26·3°C).
- 9 A.M. Sitting on top of bush and basking (A. T. 27°C).

## Forenoon—

10—11 A.M. Active.

No observations made for the remaining part of the day.

3. *Green Hoppers (I—IV stages).*

NOTE.—Observation made in April-May 1935 in field cages and in September-October 1935 in the field.

## Morning—

- 6 A.M. No observations.
- 7 A.M. Inactive, sitting inside bush (A. T. 18°C).
- 8—9 A.M. No observations.

## Forenoon—

- 10 A.M. Crawling about on bush and sometimes hopping (A. T. 26°C).
- 11 A.M. No observations.

## Mid-day and afternoon—

- 12 NOON to 1 P.M. No observations.
- 2 P.M. Very active, jump away on approach, feeding (A. T. 34°C).
- 3—5 P.M. No observations.

## Evening—

- 6 P.M. No observations.
- 7 P.M. Mostly inside bushes, but quite active (A. T. 28·4°C).

No observations for the rest of the evening.

*B. Cold Season.*1. *Adults—*

NOTE.—Observations made in December 1934 and January 1935 in Warden cages.

## Morning—

6—7 A.M. No observations.

8 A.M. Movements beginning, but rather sluggish (A. T. 21°C.).

9 A.M. Beginning to be active; basking (A. T. 21°C.).

## Forenoon—

10 A.M. Fairly active; basking (A. T. 24°C.).

11 A.M. Active and flying about.

## Mid-day and afternoon—

12 Noon to 5 P.M.—Active and flying; copulating.

(A. T. 25°C. and rising. S. T. 27°C. and rapidly rising after mid-day).

## Evening—

6 P.M. Beginning to be sluggish (A. T. 24°C., S. T. 21°C.).

7 P.M. Sitting in corners of cage. Inactive (A. T. 22°C. S. T. 19°C.).

8 P.M. Inactive (A. T. 21°C.).

9 P.M. No observations (presumably inactive).

## Night—

No observations (presumably inactive).

*C. Mild Season.*

## 1. Adults—

NOTE.—Observations made in February and March 1935 in field cages.

## Morning—

6-7 A.M. No observations (presumably inactive).

8 A.M. Inactive (A. T. 11.5°C., S. T. 11°C.).

9 A.M. Inside bush, showing slight movements; some basking (A. T. 21°C., S. T. 21.5°C.).

## Forenoon—

10 A.M. Beginning to be active.

11 A.M. Active.

## Mid-day and afternoon—

12 Noon to 4 P.M. Active, feeding, copulating, ovipositing.

5 P.M. Beginning to retire (A. T. 23.5°C., S. T. 24.5°C.). One female was ovipositing.

## Evening—

6 P.M. Sluggish.

7 P.M. Very sluggish.

8 P.M. Inactive.

9 P.M. Inactive.

## Night—

10 P.M. Inactive. (But one female was boring in soil for oviposition). (A. T. 19°C. S. T. 18°C.).

2. *Green Hoppers (I—IV Stages)*.

NOTE.—Observations made in September 1935 in the field.

## Morning—

6 A.M. No observations.

7 A.M. Inactive.

8 A.M. Sitting on bush-tops and basking.

9 A.M. Sitting on bush-tops and basking, some feeding, (A. T. 21°C.).

## Forenoon—

10 A.M. Some sitting quietly, others feeding, (A. T. 32°C., S. T. 38.5°C.).

11 A.M. Sitting on bush-tops and basking, others moving about and feeding (A. T. 32°C., S. T. 35°C.).

## Mid-day and afternoon—

12 Noon to 5 P.M. As above.

## Evening—

6 P.M. Moving towards bush-tops; a few eating.

7 P.M. Sitting on bush-tops, some moving inside the bush (A. T. 24.8°C., S. T. 26.5°C.).

No observations made for the rest of the evening.

NOTE.—Occasionally, some hoppers were noticed to have moved from one bush to another, sometimes as far distant as 30 yards away, between forenoon and evening.

From this summary it is evident that in summer locusts begin their activity at about 7 A.M. and by 8 A.M. they are quite active and start feeding; they remain active until about 8 P.M. In winter, activity begins at about 8 A.M. and feeding starts at about 9-10 A.M. Copulation, oviposition, etc., begin about noon or somewhat earlier and may last until 5 P.M.; by 6 P.M. the locusts become rather sluggish, and at 7 P.M. are inactive in which state they remain throughout the night and until about 9 A.M. In the "Mild season" the time-relations of the daily rhythm approach the winter conditions in the early part of February, and summer conditions are approximated to in the latter part of March and in November. The above conclusions apply of course, only to a normal sunny day. As a rule, locusts become sluggish in cloudy weather, due to fall of temperature.

Many further observations, extending through a complete year, are needed to enable one to prepare a table, assigning an approximate range of activity for particular parts of the day during the different seasons of the year.

**STATEMENT K-1.**

*Results of a Biometrical Analysis, month by month, of a series of locust specimens collected mainly from the Pasni-Reks during 1935.*

N.B.—For purposes of convenience, the following U/F ratios will be considered to signify the different Phases:—

**2.05 and below:**

2.00 to 2.15 :

**2.10 and above:**

**Solitaria.**

**Transiens or Intermediate.**

Gregaria.

Month.	Place of collection.	Total number of specimens examined.	Phase of the specimens	Total number of each phase.	E/R Ratios.	Remarks.
January 1935	Pasni	12	Sol.	11	1.07, 1.09, 2.00, 2.00, 2.01, 2.02, 2.03, 2.03, 2.04, 2.04, 2.15.	Mostly <i>solitaria</i> and with traces of purple in hind-wings.
			Int.	1		
February 1935.	Pasni	10	Sol.	9	1.08, 2.00, 2.00, 2.02, 2.04, 2.01, 2.05, 2.05, 2.05.	Veins with traces of purple in hind-wings which are mostly yellow.
			Int.	1	2.07.	
March 1935.	Pasni	7	Sol.	5	1.03, 1.05, 2.03, 2.03, 2.05.	
			Int.	2	2.06, 2.13.	Hind wings yellow.
April 1935	Pasni	4	Sol.	3	2.01, 2.05, 2.05	Some with hyaline wings.
	Kahnat		Int.	1	2.09 (hyaline wings).	
May 1935	Pasni	8	Sol.	0	1.03, 2.00, 2.07, 2.03, 2.03, 2.05.	Some with hyaline wings, others bright yellow.
	Ormara Kulanch		Int.	2	2.07, 2.08.	
June 1935	Non-avail- able.					
July 1935	Pasni	10	Sol.	12	1.01, 1.05, 1.08, 2.00, 2.01, 2.03, 2.01, 2.01, 2.04, 2.04, 2.05.	Collected mostly between the 12th and 15th July.
			Int.	4	2.09, 2.12, 2.13, 2.15.	An incursion of locust on a large scale took place about the 12th July, and the migrants were largely <i>transiens</i> and <i>gregaria</i> .
			Greg.	3	2.16, 2.18, 2.21	
	Ormara	1	Greg.	1	2.29.	
August 1935.	Pasni	21	Sol.	5	1.01, 2.01, 2.01, 2.03, 2.03.	Population composed largely of migrants.
			Int.	10	2.06, 2.07, 2.07, 2.09, 2.10, 2.13, 2.13, 2.18, 2.15, 2.15.	
			Greg.	0	2.10, 2.10, 2.10, 2.21, 2.22, 2.23.	
	Ormara area.	60	Sol.	0	1.00, 1.06, 1.06, 1.08, 2.00, 2.02, 2.02, 2.03, 2.05.	Many of the specimens were either pinkish or had a pinkish tinge in the hind-wings; some were bright yellow, especially the males.
			Int.	38	2.06, 2.06, 2.07, 2.07, 2.07, 2.08, 2.09, 2.09, 2.09, 2.09, 2.09, 2.11, 2.11, 2.11, 2.11, 2.11, 2.12, 2.12, 2.12, 2.13, 2.13, 2.13, 2.13, 2.13, 2.14, 2.14, 2.14, 2.14, 2.14, 2.15, 2.15, 2.15, 2.15, 2.15.	

Month.	Place of collection.	Total number of specimens examined.	Phase of the specimens.	Total number of each phase.	E/T Ratios.	Remarks.
September 1935.	Pasni S1 . Ormara 2 .	33	Greg. .	13	2.17, 2.18, 2.19, 2.20, 2.21, 2.22, 2.22, 2.22, 2.23, 2.25, 2.26, 2.28, 2.34.	Others had fairly conspicuous stripes
			Sol. .	8	1.95, 1.99, 2.00, 2.00, 2.01, 2.01, 2.05, 2.00.	Mostly composed of July migrants, but the general population had decreased; almost all of the specimens met with showed conspicuous stripes of the Solitaria type, though the ratios varied a great deal. Most had yellowish wings.
			Int. .	16	2.08, 2.08, 2.07, 2.01, 2.09, 2.09, 2.09, 2.10, 2.10, 2.10, 2.11, 2.13, 2.14, 2.14, 2.15, 2.12.	
October 1935 12-17 x -35	Pasni .	16	Greg. .	0	2.16, 2.18, 2.19, 2.20, 2.21, 2.21, 2.22, 2.24, 2.20.	Population had greatly diminished. Specimens rather dark and conspicuously striped. Hind-wings showed traces of purple and light blue.
			Sol. .	4	2.00, 2.01, 2.02, 2.05.	
			Int. .	6	2.06, 2.07, 2.13, 2.14, 2.15.	
23-30 x -35	Pasni .	21	Greg. .	6	2.16, 2.16, 2.17, 2.17, 2.19, 2.23.	Mostly remnants of the July migrants.
			Sol. .	8	1.94, 1.94, 1.96, 1.96, 1.96, 1.97, 2.03, 2.04.	
			Int. .	6	2.06, 2.08, 2.09, 2.10, 2.11, 2.15.	
November 1st Fortnight. 1-15 x 1-35	Pasni .	24	Greg. .	7	2.16, 2.16, 2.16, 2.17, 2.17, 2.18, 2.21.	The proportion of Solitaria greatly increased during the month and as most of them had bluish or purplish hyaline hind-wings, they probably belong to a recent brood. As similar forms have been noted at Ambagh, Hingol and Ormara since the middle of October, it is considered that they are probably migrants from the Rajputana Desert areas. A few of the old July migrants also found.
			Sol. .	14	1.94, 1.95, 1.96, 1.97, 1.97, 1.98, 1.98, 1.99, 2.01, 2.01, 2.03, 2.03, 2.04, 2.04.	
			Int. .	10	2.06, 2.08, 2.08, 2.11, 2.11, 2.13, 2.13, 2.14, 2.15, 2.15.	
End Fortnight 20-30 x 1-35	Pasni .	27	Sol. .	20	1.83, 1.92, 1.92, 1.93, 1.93, 1.95, 1.95, 1.96, 1.97, 1.97, 1.98, 1.98, 1.99, 2.00, 2.00, 2.00, 2.00, 2.00, 2.04, 2.05.	
			Int. .	5	2.10, 2.11, 2.11, 2.12, 2.14.	
			Greg. .	2	2.10, 2.22.	

STATEMENT No. K-2.

*Results of a Biometrical Analysis, month by month, of all available locust specimens collected mostly on the Malabar coast  
reks during 1934.*

(N.B.—For purposes of convenience, the following E/F ratios will be considered to signify the different Phases :—  
2.05 and below : *Solitaria*.  
2.06 to 2.15 : *Transiens* or *Intermediate*  
2.16 and above : *Gregaria*.)

Month.	Place of collection.	Total number of specimens examined.	The phase of the specimens.	Total number of each phase.	The E/F ratios of all the specimens examined.	Remarks.
January, February and March 1934.	Preserved specimens not available.					
April 1934	Gwadar 1 (G) Pasni 3 (P)	..	Solitaria.	0	1.90 (O), 1.92 (A), 1.95 (O), 2.00 (O).	Specimens mostly with bright stripes and yellow hindwings.
	Ormara 3 (O) Awarani 1 (A)	.. 8	Intermediate	2	2.00 (P), 2.03 (P), 2.07 (G), 2.13 (P).	
May 1934	Pasni 3 Gwadar 1 (G)	.. 4	Solitaria. Intermediate Gregaria.	1 2 1	1.92 2.07, 2.12 2.20 (G)	2.20 with almost hyaline, and 2.12 with pinkish hindwings. Apparently both were recently fledged ones.
June 1934	Pasni	2	Solitary.	2	1.98, 2.01.	
July 1934	Pasni 2 (P) Fishkan 1 (Fn) Kappari 1 (K)	.. .. 4	Solitaria. Intermediate Gregaria.	Nil 2 2	2.10 (K), 2.11 (P), 2.20 (Fn), 2.26 (P).	All specimens appear to be locusts of a recently developed brood.

Month.	Place of collection.	Total number of specimens examined.	The phase of the specimens.	Total number of each phase.	The E/F ratios of all the specimens examined.	Remarks.
August 1934 .	Pasni 1 (P) Gwadar 1 (G)	2 ..	Solitary . Intermediate .	1 1	2.03 (G). 2.06 (P)	Locust scarce in all relays.
September 1934.			No specimens preserved.			
October 1934 .	Gwadar .	2	Solitaria .	2	2.00, 2.04	2.04 Hind-wings purplish. Stray specimens found at Gwadar, but none on the Pasni relays.
November 1934	..	..	..	..	....	No locusts were found anywhere on the Mokran relays.
December 1934	Gwadar 1 (G) Pasni 6	7	Solitaria . Intermediate .	5 2	1.93, 1.96, 1.96, 2.01, 2.01, 2.01 (G). 2.05, 2.07	All specimens showed purplish tinge in the hindwings. They appear also to be a recently developed brood.

## STATEMENT NO. L.

*Statement showing the staff employed under the Locust Research Entomologist to the Imperial Council of Agricultural Research, Karachi, during 1935-36.*

Name and Designation.	Date of appointment.	Present pay (on 1st Dec. 1935).	Remarks.
<b>A.—HEADQUARTERS.</b>			
1. Rao Sahib Y. Ramchandra Rao, M.A., F.R.E.S., Locust Research Entomologist, Karachi.	13th Dec. 1930	Rs. 1,000 <i>plus</i> Karachi Local Allowance Rs. 60 per mensem.	On Foreign Service.
2. Mr. Abdul Ghani, Head Clerk.	11th Jan. 1931	Rs. 140 <i>plus</i> Karachi Local Allowance Rs. 12-8 per mensem.	Do.
3. Mr. R. L. Mehta, B.A., Second Clerk.	19th Feb. 1935	Rs. 50 <i>plus</i> Karachi Local Allowance Rs. 7-8 per mensem.	
4. Mr. H. G. Sheikh, Third Clerk.	2nd Oct. 1933	Rs. 30 <i>plus</i> Karachi Local Allowance Rs. 7-8 per mensem.	
5. Mr. Rashid Ahmad, B.Sc., Biometrical Assistant.	23rd Aug. 1935	Rs. 80 <i>plus</i> Karachi Local Allowance Rs. 10 per mensem.	
6. Mr. Chandar Parkash, Senior Compiling Assistant.	27th April 1933.	Rs. 80 <i>plus</i> Karachi Local Allowance Rs. 10 per mensem.	
7. Junior Compiling Assistant.	Vacant since 1st May 1935.	Rs. 50 <i>plus</i> Karachi Local Allowance Rs. 7-8 per mensem.	
8. 2 Draftsmen . . . . .	..	Rs. 45 <i>plus</i> Karachi Local Allowance Rs. 7-8 per mensem, each.	
<b>Fieldmen.</b>			
1 Fieldman on Rs. 31 . . . . .	..	Rs. 31 <i>plus</i> Rs. 6 House Rent and Karachi Local Allowance.	
1 Fieldman on Rs. 42 including Rs. 10 Motor Lorry Allowance.	..	Rs. 42 <i>plus</i> Rs. 6 House Rent and Karachi Local Allowance.	
<b>Peons.</b>			
1 Peon on Rs. 18 <i>plus</i> Rs. 6 House Rent, etc., per mensem.	..	Rs. 18 <i>plus</i> Rs. 6 House Rent and Karachi Local Allowance.	
2 Peons on Rs. 17 <i>plus</i> Rs. 6 House Rent, etc., per mensem, each.	..	Rs. 17 <i>plus</i> Rs. 6 House Rent and Karachi Local Allowance, each.	



Name and Designation.	Date of appointment.	Present pay (on 1st Dec. 1935).	Remarks.
<b>B.—SURVEY PARTY.</b>			
1. Mr. Keshodas Bawoja, M.Sc., Locust Research Assistant, Bikaner. Post vacant from 1st Sept. 1935.	12th Dec. 1930	Rs. 304 per mensem .	On long leave ex-India from 1st Sept. 1935.
2. Mr. Desraj Bhatia, M.Sc., Locust Research Assistant, Barmer.	2nd Jan. 1931	Rs. 170 per mensem.	
<i>Fieldmen.</i>			
1 Fieldman on Rs. 32 .	..	Rs. 32 per mensem,	
4 Fieldmen on Rs. 31 .	..	Rs. 31 per mensem, each.	
3 Fieldmen on Rs. 30 .	..	Rs. 30 per mensem, each.	
<i>Messengers.</i>			
8 Messengers on Rs. 12 .	..	Rs. 12 per mensem, each.	
<i>Peons.</i>			
1 Peon at Bikaner on Rs. 16.	..	Rs. 16 per mensem.	
1 Peon at Barmer on Rs. 15.	..	Rs. 15 per mensem.	
<b>C.—PASNI, ETC.</b>			
1. Dr. K. R. Karandikar, Ph.D., Assistant Locust Research Entomologist, Pasni, on Rs. 390 per mensem.	18th Oct. 1931	Rs. 390 per mensem .	Resigned from 9th Sept. 1935.
Dr. M. L. Roonwal, Ph.D. Assistant Entomologist, on Rs. 260 plus Rs. 50 Mekran Allowance.	6th Nov. 1935	Rs. 260 plus Rs. 50 Mekran Allowance per mensem.	
2. Syed Mohammed Taqi Ahean, M.Sc., Locust Research Assistant, Pasni, on Rs. 135 plus Rs. 25 Mekran Allowance.	28th Mar. 1934	Rs. 135 plus Rs. 25 Mekran Allowance per mensem.	
3. Mr. Rahmatullah Butt, M.Sc., Locust Research Assistant, Pasni.	12th Dec. 1935	Rs. 125 plus Rs. 25 Mekran Allowance per mensem.	
4. Mr. Abdul Halim, Clerk, on Rs. 56 per mensem.	10th June 1932	Rs. 56 per mensem.	

Name and Designation.	Date of appointment.	Present pay (on 1st Dec. 1935).	Remarks.
<i>C.—PASNI, ETC.—contd.</i>			
<i>Fieldmen.</i>			
4 Fieldmen on Rs. 42 (Pasni, Turbat, Ormara and Gwadar).	..	Rs. 42 per mensem, each.	
4 Fieldmen on Rs. 40 at Pasni.	..	Rs. 40 per mensem.	
2 Fieldmen on Rs. 20 at Pasni (Local).	..	Rs. 20 per mensem.	
<i>Messengers.</i>			
5 Messengers on Rs. 12 (Pasni, Turbat, Gwadar and Ormara).	..	Rs. 12 per mensem.	
<i>Peons.</i>			
3 Peons on Rs. 18 (including one for Mekran Survey work—transferred from A.—Head-quarters).	..	Rs. 18 per mensem, each.	
1 Water carrier on Rs. 12	..	Rs. 12 per mensem.	
<i>AMBAGH LABORATORY.</i>			
1. Mr. Ramnath Batra, M.Sc., Locust Research Assistant on Rs. 125 plus Rs. 25 Mekran Allowance.	27th May 1935.	Rs. 125 plus Rs. 25 Mekran Allowance per mensem.	
<i>Fieldmen.</i>			
1 Fieldman on Rs. 41	..	Rs. 41 per mensem.	
1 Fieldman on Rs. 40	..	Rs. 40 per mensem.	
1 Fieldman on Rs. 32	..	Rs. 32 per mensem.	
<i>Messengers.</i>			
3 Messengers on Rs. 12	..	Rs. 12 per mensem.	
1 Peon on Rs. 18 p mensem.	..	Rs. 18 per mensem.	

Y. RAMCHANDRA RAO,

Locust Research Entomologist to the Imperial Council of  
Agricultural Research, Karachi.

The 21st December 1935.

## STATEMENT NO. M.

*Statement showing the actual and probable expenditure of the office of the Locust Research Entomologist to the Imperial Council of Agricultural Research, Karachi, for the year 1935-36.*

Budget Sub-Heads.	Actuals upto 30-11-35 (for 8 months).	Probable for 4 months.	Probable Total Expenditure for year.	Sanctioned Grants.	Probable.	
					Savings.	Additional requirements
<b>A.—HEADQUARTERS.</b>						
<i>I.—Pay.</i>						
1. Pay of Officers . . . . .	8,050	1,000	12,050	12,000	...	950
2. Pay of Establishment . . . . .	4,205	2,615	6,820	8,534	1,714	...
<i>II.—Allowances, Honoraria, etc.</i>						
1. House Rent and other allowances to —						
1. Officers . . . . .	690	210	930	720	...	210
2. Establishment . . . . .	626	321	950	1,280	330	...
<i>Travelling Allowance.</i>						
3. Officers . . . . .	2,015	1,952	4,000	2,500	..	1,500
4. Establishment . . . . .	464	336	800	1,500	700	...
<i>III.—Contingencies, Supplies and Services.</i>						
1. Contingencies, etc. . . . .	1,657	1,193	2,550	4,000	1,150	...
<i>IV.—Grants-in-aid, etc.</i>						
1. Leave and Pension contributions of lent staff:—						
(a) Officers . . . . .	1,880	950	2,830	2,760	...	7
(b) Establishment . . . . .	103	99	292	605	316	...
Grand Total . . . . .	29,713	11,709	32,422	33,902	4,210	2,780
					+1,480	
<b>B.—SURVEY PARTY.</b>						
<i>I.—Pay.</i>						
1. Pay of Establishment . . . . .	6,888	2,052	9,570	10,517	917	...
<i>II.—Allowances, Honoraria, etc.</i>						
House Rent and other allowances to Establishment . . . . .	38	...	59	144	86	...
Travelling Allowance of Establishment . . . . .	4,207	2,733	7,000	4,000	...	3,000
<i>III.—Contingencies, Supplies and Services.</i>						
Contingencies, etc. . . . .	2,508	902	3,500	3,000	...	500
<i>IV.—Grants-in-aid.</i>						
Leave and Pension contribution of lent staff . . . . .	410	...	410	831	424	...
Grand Total . . . . .	11,221	6,317	20,538	18,405	1,457	3,500
					—2,043	

Budget Sub-Heads.	Actuals up to 30-11-35 (for 8 months).	Probable for 4 months.	Probable Total Expendi- ture for year.	Sanctioned Grants.	Probable.	
					Savings.	Additional require- ments.
<b>C.—PASEL.</b>						
<b>I.—Pay.</b>						
Pay of Establishment . . . .	10,002	5,498	15,500	11,016	...	1,484
<b>II.—Allowances, Honoraria, etc.</b>						
House Rent and other allowances to Establishment . . . . .	332	578	810	900	...	10
Travelling Allowance to Establish- ment . . . . .	1,741	2,760	7,500	1,000	...	3,500
<b>III.—Contingencies, Supplies and Services.</b>						
Contingencies, etc. . . . .	2,148	2,352	1,500	3,000	...	1,500
	17,223	11,187	28,110	21,016	...	—0,494
Construction of Laboratory and Residential quarters at Parel . .	3,581	4,410	8,000	Rs. 8,000 was provided for in the budget for 1934-35.		
<b>Summary.</b>						
A.—Headquarters. . . . .			32,122	83,902	1,160	
B.—Survey Party . . . . .			20,578	18,105	—2,013	
C.—Parel . . . . .			28,410	21,016	—6,401	
			81,370	71,413	—7,057	

**N.B.—**

1. The expenditure under 'Pay' includes also the pay of officer and establishment for the month of March 1935, paid in April 1935.

2. The increase of expenditure on account of Travelling Allowance under the three divisions of the Scheme is due to the following reasons:—

A.—*Headquarters.*—Travelling Allowance of officer. The Locust Research Entomologist had to pay frequent visits to Parel in connection with periodical inspection work, as desired by the Locust Committee.

B.—*Survey Party.*—Travelling Allowance of staff for December 1934 to March 1935 which could only be paid early in April 1935. It is also due to the larger number of tours undertaken in connection with the appearance of locusts in July 1935 in Sind and Rajputana.

C.—*Parel.*—Travelling Allowance of Establishment. The expenditure includes about Rs. 2,500 on account of Travelling Allowance of staff for December 1934 to March 1935, which was paid only in April 1935 and also to frequent transfers of the Research Assistants from Parel to Ambagh and vice versa.

**Y. RAMCHANDRA RAO,**

*Locust Research Entomologist to the Imperial Council  
of Agricultural Research, Karachi.*

*The 21st December 1935.*

## STATEMENT No. N.

*Budget estimates of the Office of the Locust Research Entomologist to the Imperial Council of Agricultural Research, Karachi, for the year 1936-37.*

## A.—HEADQUARTERS.

## I.—Pay.

	Rs.	Rs.
1. Pay of Officer (Locust Research Entomologist) on Rs. 1,000 per mensem . . . . .		12,000
2. Pay of Establishment :—		
1 Head clerk on Rs. 140 up to 8th June and on Rs. 150 from 9th June 1936 . . . . .	1,778	
1 Second clerk on Rs. 65 per mensem . . . . .	780	
*1 Third clerk on Rs. 50 per mensem . . . . .	600	
1 Typist on Rs. 40 per mensem . . . . .	480	
1 Assistant Entomologist on Rs. 200 . . . . .	2,400	
1 Biometrical Assistant on Rs. 125 . . . . .	1,500	
1 Compiling Assistant on Rs. 84 . . . . .	1,008	
1 Compiling Assistant on Rs. 50 . . . . .	600	
1 Draftsman on Rs. 45 per mensem . . . . .	540	
1 Fieldman on Rs. 32 per mensem . . . . .	384	
1 Fieldman on Rs. 33 per mensem . . . . .	396	
1 Lorry allowance to a Fieldman at Rs. 20 . . . . .	240	
1 Peon at Rs. 18 per mensem . . . . .	216	
2 Peons at Rs. 17 per mensem each . . . . .	408	
*1 Peon on Rs. 17 per mensem . . . . .	204	
		<hr/> 11,534

## II.—Allowances, Honoraria, etc.

1. House Rent and other Allowances :—	
(a) Officer (L. R. E. Karachi) at Rs. 60 per mensem . . . . .	720
(b) Establishment . . . . .	1,572
2. Travelling Allowance :—	
(a) Officer (L. R. E. Karachi) . . . . .	4,000
(b) Establishment . . . . .	1,500

## III.—Contingencies, etc.

Contingencies, Supplies and Services . . . . .	4,000
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## IV.—Grants-in-aid, etc.

## Leave and Pension Contributions :—

(a) Officer . . . . .	2,760
(b) Establishment . . . . .	305

Grand Total for A.—Headquarters . . . . . 38,301

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\* These are additional posts.

## B.—SURVEY PARTY.

<i>I.—Pay.</i>	Rs.	Rs.
<b>Pay of Establishment :—</b>		
1 Locust Research Assistant on Rs. 180 per mensem . . . . .	2,100	
1 Locust Research Assistant on Rs. 125 per mensem . . . . .	1,500	
1 Fieldman on Rs. 33 per mensem . . . . .	396	
4 Fieldmen on Rs. 32 per mensem each . . . . .	1,536	
3 Fieldmen on Rs. 31 per mensem each . . . . .	1,116	
8 Messengers on Rs. 12 per mensem each . . . . .	1,152	
*4 Observers on Rs. 18 per mensem each . . . . .	864	
2 Peons on Rs. 16 per mensem each . . . . .	384	
		9,108
<i>II.—Allowances, Honoraria, etc.</i>		
Travelling Allowance of Establishment . . . . .		6,000
<i>III.—Contingencies, etc.</i>		
Contingencies, Supplies and Services . . . . .		4,000
Grand Total for B.—Survey Party . . . . .		19,108

## C.—PUSNI, ETC.

<i>I.—Pay.</i>		
<b>Pay of Establishment :—</b>		
<i>1. Pusni—</i>		
1 Assistant Entomologist on Rs. 260 per mensem . . . . .	3,120	
1 Locust Research Assistant on Rs. 145 . . . . .	1,740	
1 Locust Research Assistant on Rs. 125 . . . . .	1,500	
1 Clerk on Rs. 60 per mensem . . . . .	720	
4 Fieldmen on Rs. 43 per mensem each . . . . .	2,064	
3 Fieldmen on Rs. 41 per mensem each . . . . .	1,476	
1 Fieldman on Rs. 40 per mensem . . . . .	480	
2 Fieldmen on Rs. 21 per mensem each (local) . . . . .	501	
3 Messengers on Rs. 12 per mensem each . . . . .	432	
*1 Fieldman on Rs. 40 per mensem (for Turbat) . . . . .	480	
*1 Messenger on Rs. 12 per mensem (for Turbat) . . . . .	144	
3 Peons on Rs. 18 per mensem each . . . . .	648	
1 Water-carrier on Rs. 12 per mensem . . . . .	144	
1 Sweeper on Rs. 20 per mensem . . . . .	240	
		13,692
<i>2. Ambagh—</i>		
1 Locust Research Assistant on Rs. 145 . . . . .	1,740	
1 Fieldman on Rs. 42 per mensem . . . . .	504	
1 Fieldman on Rs. 41 per mensem . . . . .	492	
1 Fieldman on Rs. 33 per mensem . . . . .	396	
3 Messengers on Rs. 12 per mensem each . . . . .	432	
1 Peon on Rs. 18 per mensem . . . . .	216	
		3,780

\* These are additional posts.

C.—PASNI, ETC.— *ontd.*

• Rs.

\_R\_.

*II.—Allowances, Honoraria, etc.*

1. Compensatory Local Allowances to the Research Assistants at Pasni and Ambagh .
2. Travelling Allowance of Establishment .

1,500

6,000

*III.—Contingencies, etc.*

Contingencies, Supplies and Services . . .

4,000

Grand Total for C.—Pasni, etc.

28,972

*Summary.**Main Scheme—*

A.—Headquarters . . . . .	38,391
B.—Survey Party . . . . .	19,108
C.—Pasni, etc. . . . .	28,972

Grand Total . . . 86,471

Y. RAMCHANDRA RAO,

*Locust Research Entomologist, Karachi.**The 21st December 1935.*

